STOCKPILE AND ACCESSIBILITY OF STRATEGIC AND CRITICAL MATERIALS TO THE UNITED STATES IN TIME OF WAR

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HEARINGS

BEFORE THE

SPECIAL SUBCOMMITTEE ON MINERALS, MATERIALS, AND FUELS ECONOMICS

OF THE

COMMITTEE ON INTERIOR AND INSULAR AFFAIRS UNITED STATES SENATE

EIGHTY-THIRD CONGRESS

SECOND SESSION

PURSUANT TO

S. Res. 143 and S. Res. 271

RESOLUTIONS TO INVESTIGATE THE ACCESSIBILITY AND AVAILABILITY OF SUPPLIES OF CRITICAL RAW MATERIALS

PART 12

Titanium—Supplement to Part 3

OCTOBER 22, 23, NOVEMBER 19, AND DECEMBER 6, 1954

Printed for the use of the Committee on Interior and Insular Affairs

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STOCKPILE AND ACCESSIBILITY OF STRATEGIC AND CRITICAL MATERIALS TO THE UNITED STATES IN TIME OF WAR

FRIDAY, OCTOBER 22, 1954

UNITED STATES SENATE,
MINERALS, MATERIALS, AND FUELS ECONOMIC SUBCOMMITTEE
OF THE COMMITTEE ON INTERIOR AND INSULAR AFFAIRS,
Henderson, Nev.

The subcommittee met at 10 a. m., in the Colorado River Water Commission offices, Henderson, Nev., Senator George Malone, presiding.

Present: Senators George Malone (presiding) and Ernest Brown.

Also present: Jerome Alderman, counsel; Arthur M. Smith, administrative assistant to Senator Malone.

(The following comments of Hon. James E. Murray were subsequently received for the record:)

JULY 26, 1955.

Extensive hearings were held on titanium beginning September 1953 and ending with the hearings in October, November, and December 1954. These hearings were mainly directed toward stimulating an expanded production of sponge titanium and securing an added source of power. Only minor attention was given to the quality of primary material, semifabrication, or to the problems of its ultimate use.

Information has come to my attention in recent weeks indicating that so much progress has been made in all phases of the entire industry beginning with the primary production and on through to its ultimate use, that virtually all technique prior to January 1955 is now obsolete. This is very gratifying in view of some of the disparaging propaganda which has appeared.

Our most progressive aircraft companies are strongly of the opinion that the quality of the primary metal has so improved and the technique of machining developed to such a satisfactory degree, that there is no reason why titanium should not now be used on a much larger scale than has been attempted heretofore.

It is expected that future hearings will show a full and well-rounded picture of the entire subject. Not only is our national defense involved, but the Government has a huge investment that must be protected.

JAMES E. MURRAY, *Chairman.*

Senator MALONE. The subcommittee will be in order.

The Minerals, Materials, and Fuels Economic Subcommittee of the Interior and Insular Affairs Committee is continuing its hearings started last year, under Senate Resolution 143 and in 1954 and 1955 under Senate Resolution 271.

I submit a copy of the resolution for the record at this point. It reads as follows:

Resolved, That the Senate Committee on Interior and Insular Affairs, or any duly authorized subcommittee thereof, is authorized and directed (1) to (continue) investigate and study the accessibility of critical raw materials to the United States in time of war and for the expanding economy in time of peace; (2) to make a full and complete invest'gation and study of new developments

and discovery of materials including synthetics which may be used as substitutes and replacements of critical materials, and further to study the progress of research programs, pilot-plant operations, processing and beneficiating methods of critical materials and minerals including fuels; (3) to make a full and complete investigation and study of the best means, methods, and devices to foster the greatest measure of self-sufficiency of critical materials that can be produced within the United States and the Western Hemisphere and to expand and develop the strategic materials industry; (4) to make a full and complete investigation, and study the status of the stockpile program, its goals, methods, and amounts of acquisition, storage, warehousing, and rotation programs; (5) to make a full and complete investigation and study the available fuel reserves of the United States and the Government regulations affecting such resources and to formulate and meet the needs of the peacetime economy and for the national security in time of war; and (6) to report to the Senate at the earliest possible date, not later than January 31, 1955, the results of its investigation and study, together with its recommendations.

The work of the committee up to the adjournment of the Congress in August of this year was conducted and the report made under Senate Resolution 143, a copy of which I will submit for the record at this time.

(The resolution referred to follows:)

[S. Res. 143 (Rept. No. 689), 83d Cong., 1st sess.]

RESOLUTION

Resolved, That the Senate Committee on Interior and Insular Affairs, or any duly authorized subcommittee thereof, is authorized and directed

(1) To make a full and complete investigation and study of the accessibility of critical raw materials to the United States during a time of war;

(2) To study and recommend methods of encouraging developments to assure the availability of supplies of such critical raw materials adequate for the expanding economy and the security of the United States;

(3) To report to the Senate at the earliest possible date, not later than January 31, 1954, the results of its investigation and study, together with its recommendations.

The two resolutions were very similar, calling for the same type of an investigation, but the second resolution, 271, was a little more all inclusive.

Senator MALONE. At the time of our previous hearings the Titanium Corp. was manufacturing approximately 4 tons of titanium per day on a 10-ton-per-day contract with the General Services Administration. Not all of the titanium manufactured met specifications. The subcommittee determined that we were manufacturing in the United States about 2,000 to 2,500 tons of titanium annually, about two-thirds of which was being manufactured here in Henderson, the other third by the Du Pont Corp. in New Jersey; and according to the testimony of Donald Douglas, of Douglas Aircraft, Robert Gross, of Lockheed, and other outstanding authorities we needed approximately 150,000 tons of titanium for national defense alone.

Also it developed that there is a tremendous demand for titanium for the manufacture of commercial planes and for the chemical industry. Because of its resistant qualities it is very valuable for many private industries.

Now the committee is not entirely satisfied with the progress being made in the manufacture and use of titanium. The committee is interested in the availability of this material and it is only one of 77 critical materials.

The only material that we intend to cover here is titanium. But the subcommittee is interested in the ability of these companies to

increase the manufacture of titanium. We want to know from the interested parties the amount of power they are using, their demand for additional power, both now and for the next 2 or 3 years—1955, 1956, 1957—as far as it is possible to estimate.

We understand that since the hearings Titanium Corp. has brought its production up to 10 tons per day, and that they are now meeting specifications. We also understand that they want to secure an additional contract from the GSA of approximately 15 tons per day. If they are ready for it and have the power in the opinion of the subcommittee there is no reason why they should not be awarded such a contract.

Senator MALONE. Mr. Gumbel, will you come forward?

Mr. GUMBEL. Senator, I have prepared a story.

Senator MALONE. You have a written statement you would like to read?

Mr. GUMBEL. Yes, sir.

Senator MALONE. You go right ahead in your own way and then we will try to establish just the status of the program.

STATEMENT OF IRVING GUMBEL, DIRECTOR, EMERGENCY PROCUREMENT SERVICE, GENERAL SERVICES ADMINISTRATION, WASHINGTON, D. C.

Mr. GUMBEL. It is a pleasure to appear before your committee again and to tell you what progress has been made in the expansion of domestic titanium facilities and the outlook for the immediate future.

Our activities are conducted, as you know, under the authority of the Defense Production Act of 1950 as amended. The programs for titanium expansion are established by the Office of Defense Mobilization based upon requirements submitted by the various defense agencies. General Services Administration has the responsibility for negotiating contracts with industry to fulfill these programs.

PROGRESS IN MANUFACTURE OF TITANIUM

Our first contract was signed in August 1951, and provided for the equipping of the Titanium Metals Co. plant here at Henderson. The next contract was signed in July 1952, and provided for the expansion of the 900 ton per year Du Pont plant near Wilmington, Del., to 3,600 tons per year. In other words, an expansion of 2,700 tons.

We signed the third contract on July 31, 1953, which provided for a 6,000-ton plant to be built by Cramet at Chattanooga, Tenn. That company is a subsidiary of the Crane Co. of Chicago.

In the meanwhile, in order to help supply existing demands, we contracted with the Bureau of Mines for the production of about 20 tons per month at its station at Boulder City. This contract has since expired.

We were originally authorized to contract for 25,000 tons yearly production. This was increased to 35,000 tons in 1954. During the entire period we had canvassed all potential producers of the material in an effort to get contractors willing to enter into contracts for large-scale production.

The lack of an established market and the then prevailing belief that the Kroll process would shortly be supplanted by improved

methods made prospective contractors hesitant about embarking on such a venture even under Government sponsorship.

The work of your committee during the latter part of 1953 in giving widespread publicity to the necessity of large supplies of titanium greatly increased interest among those segments of industry able to undertake such projects, and has played a major part in helping us toward our goal.

The Du Pont expansion reached capacity production in August of this year, which was very gratifying, since it was not expected to come into full production until December. The plant at Henderson, after requiring various process improvements, reached capacity operations early this fall. Some experimental production has been attained by the Chattanooga plant, and it is expected to commence producing about February 1, 1955, with full production coming in a year later.

In July 1945, a contract was made with Dow Chemical Co. for a plant which is expected to add 1,800 tons a year to the total. This plant is to be completed within 2 years and will be located at Midland, Mich.

In September 1954, a contract was entered into with Union Carbide & Carbon Corp., for a 7,500-ton plant at Ashtabula, Ohio. This, too, will be completed within 24 months.

This brings the total annual capacity under contract, plus the 900 tons per year which existed in Delaware, to 22,500 tons. Of this, 7,200 tons is actually producing at capacity now.

In order to permit these plants to continue operating at capacity and to avoid loss of production, a revolving fund for the purchase of titanium sponge has been set up and is being administered by GSA. It provides that the GSA will purchase all specification-grade material produced in excess of current military and civilian requirements.

Those purchases are made at the market. It is then available for resale to industry during periods when demand will exceed production. As of September 30, 1954, we had about 1,600 tons on hand, all good quality, usable material.

Although a stockpile objective for titanium sponge has been established since your last hearing, no purchases have as yet been made pending a decision by ODM on specifications and the issuance of a purchase schedule. With the establishment of national stockpile requirements even greater support will be available for the expansion of the titanium-producing capacity.

The contract with the Bureau of Mines for 20 tons monthly production terminated last month. Considerable thought was given to maintaining it as a producing plant because the material was of good quality and its cost was comparatively low. It was decided, however, that this Government owned and operated plant should not compete in the commercial market, particularly since it could play a more important role in the development of new techniques and methods. It is now planned that the facilities and its highly qualified staff will be devoted to the development of methods for utilizing domestic ilmenite ores for the recovery of metallic titanium under a contract now being negotiated.

USE OF DOMESTIC ORES

As you pointed out, the Government is particularly interested in having titanium produced from domestic ores rather than from imported ores. At the present time most production comes from imported ores, but we feel that the Bureau of Mines plant here can do a very valuable job in developing processes for using low-grade ores economically.

Senator MALONE. The subcommittee will be very happy to know that because it seemed to be a very dangerous situation for us to be dependent on offshore areas across major oceans for raw material for the manufacture of titanium, and we are dependent upon such sources right here at this plant. Is that not so?

Mr. GUMBEL. I would like to modify that a little bit, Senator. What you say is quite true. We have realized that difficulty, and all our contracts provide that the plants must be constructed so as to be able to convert if they do not use ilmenite in the beginning, to the use of domestic ores. I understand all of them can do so, but there is an economic problem. It is more costly, and that is what we hope that the Bureau of Mines will help; develop a process that will use the domestic ores economically.

Senator MALONE. Now the subcommittee has information that while it might be more expensive in the beginning to change over, if followed through, it will not be more expensive in the long run. Is that true?

Mr. GUMBEL. Senator, that is a little beyond my competence. That is one of the things we want the Bureau to tell us about.

Senator MALONE. We intend to follow through on that. Have you taken into consideration that the morning after the declaration of war you cannot get any of this offshore material?

Mr. GUMBEL. Yes, very definitely.

Senator MALONE. It might be that the cost is not so important if you think you might have a war.

Mr. GUMBEL. We do appreciate that. However, you realize that even with present methods titanium is very costly, and we would, I think, all hesitate to do anything that would make it more costly at this time.

Senator MALONE. Even if you know you could not get it the morning after war was declared?

Mr. GUMBEL. We assumed that these plants can use domestic ilmenite. The contracts provide that the plants be so constructed.

Senator MALONE. How about this one?

Mr. GUMBEL. I think it is contained in this contract, too. I am not certain of that.

Senator MALONE. Is it contained in the original contract?

Mr. GUMBEL. I would have to check that, Senator. I am not too sure. The ones since I have been in charge of have had that provision. The earlier contracts I would have to check.

Senator MALONE. That is a very dangerous situation in the opinion of the subcommittee as expressed in their report. There was apparently a planned propaganda starting back during World War II to make us dependent on offshore areas—meaning across major oceans—for the strategic and critical materials needed to fight a war.

We had a witness, Major De Seversky, one of the outstanding airmen of the world, who put more spectacular language in his testi-

mony. He said you do not make your jet engines in Cincinnati; you make them in Algeria. You don't make your steel in Pittsburgh; you make it in India, and went on and on, meaning, of course, after war began we could not make it.

Now we think you are right up against it on this material. You are letting contracts that are using rutile and rutile to any considerable extent is not available in this country—that is, to the extent it would be needed.

Now, are these contracts strongly worded so that they must be able to convert to the use of ilmenite? How long would it take them to convert?

Mr. GUMBEL. I think some of the contracts provide within 2 weeks.

Senator MALONE. You can lose a war in that time.

Mr. GUMBEL. Presumably we would get some warning before war actually broke out.

Senator MALONE. About 2 hours.

Mr. GUMBEL. I would like to add that, of course, this entire dependence of the United States on overseas sources of supply is something that has caused us a great deal of thought and consideration.

Senator MALONE. Are you also familiar with the testimony and conclusions of the committee that we need not be dependent on any area across a major ocean for this material considering substitutes and replacements?

Mr. GUMBEL. I am, sir.

Senator MALONE. And many times a substitute or replacement turns out better than the main material. You never go back to the other material. It is like this ilmenite. There is more ilmenite in the United States and Canada than this country can use in a thousand years.

Everybody knows that. Why do we persist from the beginning in using something that you have to get from a foreign nation?

Mr. GUMBEL. I think the answer to that is very simple. The problems of producing titanium as you well know, are extremely difficult and we are just beginning to get answers to some of them. As you remarked, this plant in Henderson took a long time to get into full production in order to put out specification grade material.

Now I submit to you that we should not needlessly complicate these difficulties, that we should not add additional problems until we solve the ones that we are working on. I am told by everybody that is famiilar with this matter that you can make good titanium out of ilmenite but there are so many other important problems connected with titanium that I suggest that it may be a better thing to solve the ones that are really serious, the ones that cause us to pay $5 a pound for titanium, rather than these others, but, as I said and as the testimony I have just given you of what we have decided to do at the Bureau of Mines, I think, indicates that we are very much aware of this problem and doing what we can to cure it.

Senator MALONE. I think that is a very important thing you are doing—putting the Bureau of Mines to work in determining the best method to utilize ilmenite. I only bring it back to you here that when you are dependent on an offshore area—and we are to a great extent on many of these materials—that is one way a nation may get the idea they can win a short war. It is impossible for us to have a stock-

pile that will take care of a long war. A stockpile plus the going-concern production in the Western Hemisphere can be then equal to the estimated length of any war. Go ahead.

Mr. GUMBEL. As I say, we are in the process of negotiating a contract with the Bureau of Mines at Boulder City to do this experimental work and that the titanium production plant itself when and if required will also be available to demonstrate the Kroll process to interested parties who may want to build their own Kroll plants. The privately owned plants operate on processes which they have developed themselves and which they are naturally loath to disclose to prospective competitors.

The plant at Boulder City is the only plant a person can get in and find out exactly how you make titanium.

Senator MALONE. In these contracts you are making you are still following the policy under the Kroll process or any process that you are recommending that the Government take up the check on obsolete equipment under certain conditions.

Mr. GUMBEL. Not any more. That was in the early days when we thought the Kroll plants would become rapidly obsolete. The best advice we have now is they are good for at least 5 or 10 years.

Senator MALONE. In other words, in any new contract under the Kroll process you would not include that paragraph.

Mr. GUMBEL. No protection there.

Senator MALONE. Are you finding any reluctance on the part of anyone to take the contract?

Mr. GUMBEL. No, sir. The general feeling about the Kroll process changed very substantially in the last 2 years.

Senator MALONE. Is there any improvement in the Kroll process in sight that would cheapen the manufacture?

Mr. GUMBEL. Yes. They are improving it every day. I went through the plant here today and saw the improvements that have been made since they started on this. One of the very good chances of getting down the price is in cheapening the cost of making titanium tetrachloride. I was talking to a large chemical company the other day, and they are anxious to put up a plant, and they believe they can reduce the costs substantially.

As you are aware, you use 4 pounds of titanium tetrachloride for 1 pound of titanium so that every cent you can save on the tetrachloride means a 4 cent saving on the metal.

Senator MALONE. What is the approximate cost of tetrachloride?

Mr. GUMBEL. We generally figure roughly 40 cents. That would be $1.60 for a pound of titanium.

Senator MALONE. If that could be cut in two, you would make a substantial gain.

Mr. GUMBEL. I think it is quite likely.

Senator MALONE. Go ahead.

Mr. GUMBEL. When and if required it will also be available to demonstrate the Kroll process to interested parties.

Discussions of additional production contracts with qualified producers are continuing. Several negotiations well underway are the following:

(*a*) A 7,200-ton per year plant to be built at New Johnsonville, Tenn.

Senator MALONE. Are you at liberty to name the company?

Mr. GUMBEL. Yes; it was brought out in a previous hearing. It is the Du Pont Co. The 5,400-ton increase at Henderson.

Senator MALONE. What is in the way of such expansion here?

Mr. GUMBEL. Well, I am not sure that there is anything in the way, Senator. We did not want to negotiate this new contract until we were quite sure that the plant here would be able to produce to capacity.

Senator MALONE. That is one of the purposes of your inspection this morning.

Mr. GUMBEL. No, sir. I was here and I inspected it. No; we are convinced that the plant is doing very well now and we are glad to negotiate for further expansion of it.

Senator MALONE. It will be necessary then in addition, of course, to the details as to how it is to be done and the cost and payments, to have assurance that they had the facilities here to carry it through.

Mr. GUMBEL. Yes.

Senator MALONE. That would include power?

Mr. GUMBEL. Yes.

Senator MALONE. Go ahead.

Mr. GUMBEL. (*b*) a 5,400-ton expansion of the plant at Henderson, Nev.

(*c*) A 4,000-ton plant to be established in southern California.

(*d*) A 1,000-ton per year plant originally considered for establishment in the neighborhood of Boulder City.

All of these proposals are from entities which justify the belief that they are able to construct and operate titanium facilities successfully.

A contract has also been made to investigate the possibility of using some of the Government's magnesium plants built during World War II for titanium production. The plant at Manteca, Calif., which produced magnesium using the ferrosilicon process is now being tried out for this purpose. Some titanium has already been produced there but it is too early to know whether the quality and costs will render such an operation feasible. In the event it proves successful, consideration will be given to the leasing or sale of other magnesium plants, which are now idle, for titanium production.

Other prospects are discussing the probability of entering into the titanium field but their proposals have not yet progressed to the point where it is possible to forecast either the capacity of the plant or its location.

NEW PROCESSES FOR TITANIUM PRODUCTION

The committee will be interested in a portion of our program which has to do with the development of new processes for titanium production. Under it the discoverers of new processes may submit it for Government sponsorship.

It is first reviewed on our behalf by the Materials Advisory Board which has been established by the National Research Council.

Senator MALONE. Give us an idea of what this Materials Advisory Board and National Research Council is, how it is made up.

Mr. GUMBEL. It is made up of outstanding metallurgists, scientists, university professors, and people in the business. It does a great deal of work for the Government. The Materials Advisory Board is

a segment of the Council which handles materials, mostly minerals and metals, and we use them a great deal for all of our problems in research and development of synthetics and that sort of thing.

The Board presently is composed of 3 men, 1 of whom was a former director of research for the Aluminum Co. of America and the others are 2 distinguished scientists.

Senator MALONE. The committee is very much interested in finding the reason for these delays. All the testimony from Donald Douglas of Douglas Aircraft, Robert Gross of Lockheed, and other major plane manufacturers is that this material is needed and from 25 to 40 percent can be used in the frame structure and the engines. We have had testimony from Curtiss-Wright Co. and others along the same line. It all added up to 150,000 tons a year that is needed for national defense and that they cannot start making planes and engines and putting the parts in to the extent that they would run out of titanium. They have to start very slowly. That is what makes the temporary surplus of titanium.

The subcommittee intends to investigate another angle of this situation. Every time we look around we have got another investigative setup in the titanium field to determine what they ought to do. Now you have the Army injecting itself into this business. We have, of course, the Office of Defense Mobilization, which has its Titanium Committee. You will remember when Dr. Kellogg was brought down from Columbia to take charge of a Special Committee on Titanium under the Office of Defense Mobilization naturally it took Dr. Kellogg about a year to get his feet on the ground.

I understand he has been demoted and somebody else is running it.

Mr. GUMBEL. I do not think that is quite correct. I understand Dr. Kellogg is still Chairman of the Committee. However, he has been relieved of a lot of the routine work. I think an administrative assistant or administrative director has been appointed who will handle details. But Kellogg is still very much in the picture. He still presides at the monthly meetings of the Committee and is down here very frequently to discuss specific problems.

I think we had a meeting with him 2 weeks ago to discuss this problem of a further expansion of titanium.

Now, I think what you are referring to is this Committee that has been set up by the Under Secretary of Defense for Research and Development.

Senator MALONE. Quarles?

Mr. GUMBEL. Yes.

Senator MALONE. You have the Interdepartmental Committee, in the Director of National Defense Office which is a divided authority now with Kellogg. The Department of Commerce is setting up a committee and getting into the play. They have an industrial advisory committee. Who do they advise?

Mr. GUMBEL. They advise the Business and Defense Service Administration, which is the old National Production Administration, on problems confronting the industry, such as specifications and expansion goals, and one thing and another.

Senator, that reminds me, about 2 or 3 years ago a man appeared in Washington very briefly in Government service from outside business, and he had framed on his wall a little Dutch motto which, trans-

lated, meant "When the Devil desired nothing be done, he appointed the first committee."

Senator MALONE. When you get four of them you are going right along. We could take Kellogg all right if you are going to give Kellogg authority. Now you have three others.

Mr. GUMBEL. I understand, Senator, that Dr. Kellogg is still the coordinating authority, the person who recommends action to the Director of the Office of Defense Mobilization. However, the representative of that agency is more qualified to talk on that.

Senator MALONE. We have a witness from the Office of Defense Mobilization that will clear that up but we heard he is no longer chairman.

Every time this committee looked around—and we have lots of other troubles besides titanium—we heard rumors that we have too much titanium. Now we had three hearings on titanium in Washington to clear that up and Dr. Flemming established your outfit as the organization to purchase the surplus titanium until the stockpile plus the going concern manufacture equaled enough titanium to put these aviation companies in business so they dared use it. You remember Donald Douglas and others testified that they had these planes on the drafting boards and did not dare take them off.

What are we going to do, just keep organizing committees?

Mr. GUMBEL. I think the situation has changed. We now have about 1,600 tons of titanium.

Senator MALONE. It is nothing.

Mr. GUMBEL. It will be nothing in 2 or 3 years but it is quite a bit for the moment.

Senator MALONE. It is quite a bit as long as you do not have enough to start using it.

Mr. GUMBEL. We are increasing production.

Senator MALONE. You do not have enough to start using it.

Mr. GUMBEL. There again, Senator, perhaps you should pursue that with the Office of Defense Mobilization.

Senator MALONE. Well, we will. This is the thing, too; you have a goal of 35,000 tons a year.

Mr. GUMBEL. Yes.

Senator MALONE. Who sets that goal?

Mr. GUMBEL. Dr. Flemming.

Senator MALONE. It took him 3 years to get up to the amount that the National Defense Administration represented in the first place; didn't it? Didn't they say they wanted 35,000 tons 2 years ago?

Mr. GUMBEL. I am afraid a good part of that delay is due to our slowness in negotiating the contracts, too.

Senator MALONE. I do not think you were told to put the heat on these contracts. Wasn't there a time when you were just coasting?

Mr. GUMBEL. No; I think we were always authorized to go, as I remember it, to 22,500 and it has taken a long time to draw up these contracts. You run into this sort of thing, Senator. Several months ago, I believe we testified at your last hearing, we had a very large and prominent and very able company that put in a proposal to build a 2,500-ton titanium plant and we were informed by very high officials of the company that if the Government wanted us to increase that 3 or 4 times, they would be glad to do it. Well, about a month ago they wrote us a letter and said they were sorry but were no longer

interested in going into the titanium field because they just consolidated with another company and the problems resulting from that consolidation had made them back out of the titanium field. We have those problems.

Senator MALONE. How long do you think at the rate you are going now it will take to get up to a hundred fifty thousand tons a year?

Mr. GUMBEL. Senator, I think I covered that. I do not think I have gone up to 150,000 tons, but I have some ideas in here about what I think is feasible.

Senator MALONE. Go ahead.

Mr. GUMBEL. I was speaking of our program to encourage the development of new processes and that this was first reviewed by the Materials Advisory Board. If the Board is satisfied that the idea is promising, a contract is entered into for the construction and operation at Government expense, of a pilot plant of sufficient size to provide design and cost data for a commercial plant. One such contract is now in effect with Horizons, Inc., having been signed July 1, 1954, and the plant is being constructed at Stamford, Conn.

Senator MALONE. Who is at the head of that company?

Mr. GUMBEL. Senator, there is some strong financial interest back of it. It is a research organization. I have been told that the Rockefellers have an investment in it and a number of other very powerful financial interests.

Senator MALONE. They have been given a contract?

Mr. GUMBEL. Yes, sir.

Senator MALONE. Go ahead.

Mr. GUMBEL. Negotiations are at an advanced stage on another, and at least two promising prospects are known. Discussions are also being held with a metals producer who has developed a new titanium——

Senator MALONE. I did not notice the junior Senator from Nevada, Mr. Brown, is here. Mr. Brown, will you move up to the table here? I neglected to say Mr. Souverkroup is here, representing the Governor.

I do not know if there is anyone directly representing Congressman Young. We are glad to have you here, Senator Brown. This is Mr. Gumbel of the General Services Administration in Washington, which actually makes the contracts for the production of many materials including titanium which we are interested in here today. You go ahead, Mr. Gumbel.

Mr. GUMBEL. Discussions are also being held with a metals producer who has developed a new titanium process without Government assistance, with a view to encouraging the construction of a commercial-scale plant at an early date.

To summarize, existing contracts provide for the construction of facilities capable of producing 22,500 tons of sponge annually. We have under negotiation an additional 18,200 tons which would make a total of 40,700 tons available yearly. It is probable that this figure could be further increased without difficulty. In addition, as I have mentioned, we are actively promoting improved processes for producing the metal.

All of our existing contracts relate to titanium sponge in its primary stage. However, we realize that the end product is the most important factor in titanium utilization and that there are two im-

portant manufacturing stages between the sponge and the end product.

The first is the production of an ingot from sponge and/or scrap metal. There are two separate phases of this problem, the development of improved methods and increasing commercial capacity. Under a development program we are authorized to sponsor new processes designed to produce ingot from scrap material hitherto considered unusable, to prepare sponge and scrap more efficiently or economically, and to improve the physical and chemical properties of the ingot.

With regard to increasing commercial melting facilities for scrap employing existing methods, we have just completed a study of the financial requirements for a 6,000-ton expansion program which is about to be forwarded to ODM for approval. It is anticipated that this will only be the first step in a considerably larger expansion, the ultimate extent of which will be determined by studies now in progress.

The second stage in arriving at a usable end product is the manufacture of semifabricated products such as sheet, rough forgings, plate, and extrusions. Here again both research in methods and ultimate expansion of commercial facilities are required.

With respect to research, I should mention that one of the most important factors is that of cost reduction. At the present time titanium sponge sells for a little less than $5 per pound; semifabricated titanium at from $15 to $20 per pound, with end products substantially higher.

It is believed that through new methods substantial economies can be effected down the line, with the greatest dollarwise saving being in fabricating. Responsibility for fabricating research and development on behalf of the Government has been lodged in the Office of the Under Secretary of Defense for Research and Development.

The Business and Defense Service Administration of the Department of Commerce is responsible for expansion of fabricating facilities and is actively studying this subject. If, as seems likely, such expansion will require governmental commitments in excess of rapid tax amortization, the GSA is ready and willing to negotiate the necessary contracts upon authorization by the Office of Defense Mobilization.

I have made this presentation as brief as is consistent with covering the broad aspects of our activities in titanium and I shall, of course, be glad to supply any additional information which the committee may desire.

I can only add that the matter is extremely complicated, both technically and economically, as well as being very costly. I greatly appreciate the assistance which the chairman has already rendered and which he will no doubt continue to provide.

Senator MALONE. Let me as you if in this appointment of 3 or 4 additional committees now and the general talk that emanates some place, it is hard to pin down, that the alloys are not satisfactory under certain conditions, do you detect any fine hand of any producers of other metal that this might interfere with?

Mr. GUMBEL. Senator, I can't honestly say I do, though I can readily conceive of the possibilities of that.

Senator MALONE. I listened with great interest to your naming this special committee a while ago and there was an official of the Aluminum Co. of America on it. Would that have any bearing on this question?

Mr. GUMBEL. I do not think so. He has been a research man all of his life. He is probably one of the best research men in metallurgy in the country. He has been retired from the Aluminum Co. for some years. His pension is not dependent on anything he does in the future. He gets that regardless of what happens. He does not determine any policy. He simply gives us technical information in connection with the other members of his committee.

I have a very high regard for him. His name is Frary. He is known throughout the United States.

Senator MALONE. I would not cast any reflections on anyone and did not so intend it. I served as consultant to the Senate Military Affairs Committee and Secretary of War during World War II and in that capacity I noticed that without appearing to be, there was always some kind of delay or reason why something could not be done if it interfered with something that was already being done and established.

Mr. GUMBEL. Senator, I have worked for the Government for 13 years and I think there are just delays. I think they are not Machiavellian schemes of anybody. I think it is the inefficiences with which a large Government operates. You will remember when we were trying to dispose of the basic magnesium plant in Henderson, the long delays that tok place. I think you remember the hearings we had at that time both in Washington and here. There is just a certain amount of immobility in the Government which takes it about 2 or 3 times as long to do things as possibly some of us think it ought to take.

Senator MALONE. Is there a reluctance on the part of any of your organization to take the responsibility——

Mr. GUMBEL. No, sir.

Senator MALONE. To give out these contracts.

Mr. GUMBEL. We negotiate these contracts just as rapidly as we can. However, first there is the question of the terms of the contract, both on the policy in letting contracts and then there is the legal details which have to be passed on by the legal experts. There is the comptrollers work that he has to do. It is very difficult to get anything done quickly.

Senator MALONE. Are you limited in your work, in your contracts to the 35,000 tons at this time that has been approved by the Office of Defense Mobilization?

Mr. GUMBEL. Senator, I think you will remember at one of your last hearings in Washington that Dr. Fleming appears with Mr. Mansure and I think Under Secretary Thomas and at that time it was stated that the General Services Administration would explore all interested contractors with a view to seeing whether contracts could be made with them and that we would submit any such contracts to Dr. Fleming.

In other words, he was not putting on a ceiling because of the fact that the ultimate goal could not be established. On the one hand, he did not want to make any decision, but yet he did not want to hold up any contracts that might be negotiated.

Senator MALONE. Why is he limited to 35,000 tons now when it is obvious to everyone in the country who studied it that you need 5 times that amount?

Mr. GUMBEL. I understand that he wants us to go ahead and negotiate and as we get new contracts we take them to him and then he will decide whether he wants to go above the 35,000.

Senator MALONE. Why does he have to wait?

Mr. GUMBEL. There again I think maybe the people from the Office of Defense Mobilization could give you more accurate information.

Senator MALONE. We will look forward to hearing them in Washington, but it is a source of annoyance to this subcommittee when a thing is definitely established that you still talk about cost; you talk about cost and that it is very expensive. We know it is very expensive. A jewel in a watch is expensive or a jewel in an aviation instrument is expensive but when you decide you need it you go ahead and make it, don't you?

Mr. GUMBEL. Yes; I do not think that the expense is the principal difficulty. I think there are other difficulties.

Senator MALONE. What are they?

Mr. GUMBEL. Well, I do not want to—Mr. Harris is fully prepared to discuss that and I think he can do it much more effectively than I can.

Senator MALONE. Now we have 4 committees instead of 1. We whittled it down to one. We started with about 15. Finally, you remember that loan agencies of the Government got up to about 40. We abolished the RFC and started at the top. It might be a good idea to start in on these committees and abolish them and start over. Do you think that would have the earmarks of helping this program?

Mr. GUMBEL. Well, Senator, I do not think I am quite qualified to testify on that. I accept your suggestion, though.

Senator MALONE. It is not money that is holding you back, is it?

Mr. GUMBEL. No.

Senator MALONE. There is money for all this business. If the Office of Defense Mobilization said that you are to shoot at a goal of 150,000 tons or 75,000 or 50,000, you would shoot at it?

Mr. GUMBEL. We would do our best.

Senator MALONE. You have the money to do it?

Mr. GUMBEL. It is available. It has to be allocated by the Office of Defense Mobilization.

Senator MALONE. What is involved in that allocation?

Mr. GUMBEL. Simply that—I mean if they determined they wanted 150,000 tons they would at the same time allocate the borrowing authority. There is borrowing authority at this time, I think.

Senator MALONE. That is just an order of the Board, isn't it?

Mr. GUMBEL. That is right.

Senator MALONE. Is that a difficult matter?

Mr. GUMBEL. No, sir.

Senator MALONE. Well, we will hear Mr. Harris after a little while and you will be with us until tomorrow if we need you further?

Mr. GUMBEL. I had hoped to get off tomorrow morning.

However, if you need me I will stay over.

Senator MALONE. You will be here this afternoon?

Mr. GUMBEL. Yes, sir.

Senator MALONE. Senator Brown, do you have any questions?

Senator BROWN. Not at this time, Mr. Chairman.

Senator MALONE. I would like to ask you and have you thinking about it—what is the status of the fabrication of this metal now?

Mr. GUMBEL. Senator, we will unquestionably have to have additional melting facilities to use anything like the amount of titanium we will have available in 2 or 3 years. We will also have to have a lot of auxiliary equipment, pickling and heat-treating equipment. It is my impression from talking to the industry that there is probably enough rolling and extrusion and forging capacity idle, built for other materials like iron and steel, aluminum and brass, to do the work and turn out the semifabricated products.

Senator MALONE. Is the extrusion machinery built for steel and other metals available and adaptable to the titanium?

Mr. GUMBEL. That is what I am advised.

Senator MALONE. We will hear from Mr. Harvey a little later about that. The forging of this metal—what does that entail?

Mr. GUMBEL. That entails ingot production, which is lacking, which will have to be provided, but of course you can do the forging, as I understand it, on presses that are available in industry.

Senator MALONE. Is that being promoted? Are you going ahead with part of it?

Mr. GUMBEL. The Department of Commerce, which is the agency responsible for that, is making a number of studies both on their own and with their producers committees, industrial commitees.

Senator MALONE. The Department of Commerce has come in to this a little bit new, is that right?

Mr. GUMBEL. No, Senator, they come in as successors to the National Production Administration which was abolished a couple of years ago.

Senator MALONE. What was that?

Mr. GUMBEL. Let me put it this way. Our predecessor agency, Defense Materials Procurement Agency, was responsible for the raw materials, the iron up to the open hearth furnace, the copper through the ingot stage. Then the fabricating was the responsibility of the National Production Administration and they were supposed to develop programs to expand fabricating facilities. The great expansion in steel capacity was carried out under the responsible authority of the National Production Administration.

Senator MALONE. Have you ever thought of getting one of the companies manufacturing engines and frames and working on the extrusion methods to do some of this work under the contract or in some way getting somebody who has some knowledge of it to start with?

Mr. GUMBEL. Well, Senator, I think those are the people that should do the work. I do not think the Government is qualified.

Senator MALONE. Why do we show up with another Government committee that wants to do this work?

Mr. GUMBEL. I do not think they want to do it. They want to sponsor it.

Senator MALONE. Isn't this Defense Administration Committee saying it is the Army's job to do a lot of their testing?

Mr. GUMBEL. No, sir; I do not think so. It is the Army's job to sponsor it. In the first place, the Army has been sponsoring a great deal of this work over the past 3 or 4 years. I have heard it said they have about 100 research contracts which they are sponsoring.

The feeling was that there should be some one agency of the Government to coordinate all that research and development.

As I understood it, such contracts were given out by the Bureau of Naval Research and Development. The Air Force at Wright Field and elsewhere, and the Army. This committee, as I understood it, was set up under Under Secretary Quarles to review these programs to see there was not duplication and at the same time to see that there were not areas not being covered.

Senator MALONE. Well, we will let it go at that at the present time.

Mr. GUMBEL. Thank you.

Senator MALONE. Now, Colonel McDonald is here representing the Production and Resources Division, Air Materiel Command, Wright-Patterson Air Force Base, Dayton, Ohio.

Colonel, will you take your place there and identify yourself for the purpose of the record?

STATEMENT OF COL. HENRY G. McDONALD, USAF CHIEF, PRODUCTION AND RESOURCES DIVISION, AIR MATERIEL COMMAND, WRIGHT-PATTERSON AIR FORCE BASE

Colonel MCDONALD. I am Henry G. McDonald, colonel; I am Chief of the Industrial Resources Division of the Air Materiel Command, United States Air Force.

Senator MALONE. Are you taking the place of General Metzger, generally speaking, of Wright Air Base?

Colonel MCDONALD. Yes, sir.

Senator MALONE. I am not familiar with your record but I would make the remark that it is a good-sized pair of shoes if they have given you the same authority.

Colonel MCDONALD. I could not agree more.

Senator MALONE. Does the General still have any connection with the Army or national defense in an advisory capacity?

Colonel MCDONALD. He has retired but has offered his services as consultant on a no-fee basis at any time.

Senator MALONE. Have they been accepted?

Colonel MCDONALD. Not as of the moment. He was retired at the 1st of September. I expect he will be called upon.

Senator MALONE. Do you expect to call him?

Colonel MCDONALD. Yes, sir.

Senator MALONE. Tell us for the benefit of the committee, give me your status in this thing and what are your responsibilities?

Colonel MCDONALD. Responsibility of my division with respect to titanium and other materials consists of determining requirements and of furthering the development of manufacturing methods. You touched on those, Senator, in your discussion with Mr. Gumbel.

Various methods of fabricating this material into usable shapes and forms for our airframe and engine contractors.

Senator MALONE. You take in many materials?

Colonel MCDONALD. All metals suitable for Air Force production.

Senator MALONE. Give us a general résumé.

Colonel MCDONALD. Aluminum, steel, both in the unalloyed and high alloyed steels, copper, titanium and the whole host of other metals which your committee has been considering—columbium, tungsten, and so forth.

Senator MALONE. You take in practically all of these metals that are called critical.

Colonel MCDONALD. Yes, sir.

Senator MALONE. Not from the production?

Colonel MCDONALD. No, except to point up areas of short supply.

Senator MALONE. Titanium is just one of your worries.

Colonel MCDONALD. Yes.

Senator MALONE. What progress are you making in the worrying? Will you give us a statement on it now?

PRIMARY PROBLEMS: FABRICATION AND SUPPLY

Colonel MCDONALD. All right, sir. Our primary concern, as you pointed out, is one of quality and ability to fabricate this material into usable shapes and forms. We are equally concerned about the supply. However, that is not our primary responsibilty.

Senator MALONE. Whose responsibility is it?

Colonel MCDONALD. The Office of Defense Mobilization.

Senator MALONE. Who advises them?

Colonel MCDONALD. As to requirements for the military that would be the Department of Defense based on information which we supply from Wright Field and which the Army supplies and the Navy.

Senator MALONE. It comes back to you.

Colonel MCDONALD. Yes, sir, for the determination of requirements. We tell them what we need.

Senator MALONE. What do you need?

Colonel MCDONALD. You want some figures?

Senator MALONE. Yes.

Colonel MCDONALD. As you recall, at the last hearing the Department of Defense had made an official request for capacity in the neighborhood of 35,000 tons a year by 1956. We are still calling for that same amount. However, I must report to you that our requirements have slid approximately 1 year. We see the need for that amount of material in 1957 instead of 1956. These problems of quality have been largely responsible for this.

Senator MALONE. You mean they have not produced quality of titanium you could use?

Colonel MCDONALD. Yes, sir.

Senator MALONE. Now do you think you will only need 35,000 tons by 1957?

Colonel MCDONALD. Yes, sir; based on known and anticipated improvements in the quality. Research programs under way now which enable us to see better material which will be incorporated into air frames and engines and other Air Force materiel to the extent of 35,000 tons a year by 1957.

However, if there are even more rapid strides in the technology, we can see a much greater application by that time. What we are attempting to do is extrapolate technological progress. It is all done with the full coordination of our contractors. Putting it briefly, the faster the quality advance we achieve, the faster this goal of 35,000 tons will disappear and be replaced by something considerably higher.

Senator MALONE. Aren't you reading the menu backward? Why don't you tell them how much you need of the material, workable material and tell them the specifications of the workable material and let GSA and the Defense Mobilization Administration get to work on it?

Colonel McDONALD. Sir, we will do that. As soon as the quality of the material indicates to our contractors, our airframe and engine people, that they can use more than that, they will so inform us.

Senator MALONE. Why do you tie it back to when this thing happens when, as a matter of fact, you heard the testimony that they only have authority to go to 35,000 tons and that would indicate that they have all the time in the world. Now how much could you use if it met the specifications of the enginemen and framemen?

How much could you use?

Colonel McDONALD. Your figure there is correct at about 150,000 tons a year.

Senator MALONE. Why don't you talk about it?

Colonel McDONALD. I can talk about it but not in terms of 1957.

Senator MALONE. 150,000 tons in 1957 if you had it.

Colonel McDONALD. If we had the quality right now; yes, sir.

Senator MALONE. Why don't you authorize it?

Colonel McDONALD. Because we do not have the quality. The material would be——

Senator MALONE. You will never have it if you do not authorize it.

Colonel McDONALD. The material could be produced but never used in our airframes and engines.

Senator MALONE. We are about to hear further testimony on this. Will you stay and hear it?

Colonel McDONALD. Yes, sir.

Senator MALONE. And if there is anything else the matter with it, I want you to point it out.

Colonel McDONALD. These things, quality problems which are confronting our contractors, are more than the sponge quality. They have very nearly licked the problem of sponge quality.

Senator MALONE. What are they?

Colonel McDONALD. Problems in alloying and fabricating the material to meet specifications established by our contractors, not by the Air Force. Those problems are constantly hampering efforts to build titanium into our equipment. We have one engine program which we felt was very promising which has slid a complete year because the engine simply will not run with material they were able to get at the time they fabricated the engine.

Senator MALONE. Let us get back on your demand. Two years ago the Office of Defense Administration informed the Mobilization Administration that you wanted 35,000 tons, didn't you?

Colonel McDONALD. Yes, sir.

Senator MALONE. They authorized what?

Colonel McDONALD. Ultimate authorization got up to 22,500, as I recall and later raised to 35,000 before the new——

Senator MALONE. Why is that? Who made that decision and cut you down?

Colonel McDONALD. The Office of Defense Mobilization.

Senator MALONE. Why?

Colonel McDONALD. On the basis, I assume, they did not feel there was a requirement in that amount.

Senator MALONE. In other words, that you did not know what you were talking about?

Colonel McDONALD. A difference of opinion.

Senator MALONE. The opinion developed by Donald Douglas and as long as he makes most of your frames and Bob Gross of Lockheed, that they know something about it would you assume they would?

Colonel MCDONALD. Absolutely. We rely entirely on their judgment.

Senator MALONE. They testified you need 150,000 tons. Who is giving advice to the Office of Defense Mobilization?

Colonel MCDONALD. The advice to the Office of Defense Mobilization comes from the three military departments and the Department of Defense so far as defense requirements are concerned.

Senator MALONE. I am quoting you that you ordered 35,000 tons and were cut to 22,500?

Colonel MCDONALD. That is right.

Senator MALONE. That is true.

Colonel MCDONALD. That is true.

Senator MALONE. Who intervened?

Colonel MCDONALD. I do not understand, Senator.

Senator MALONE. Who is between you and the Office of Defense Mobilization that convinces them you do not know what you are talking about?

Colonel MCDONALD. This I do not know.

Senator MALONE. Are you in a position to find out?

Colonel MCDONALD. Not as far as I know the channel there is direct from the Department of Defense to the Office of Defense Mobilization.

Senator MALONE. Somebody cut it down and did not think you knew what you were talking about and did not need that much.

Colonel MCDONALD. Yes, sir.

Senator MALONE. Have you talked to them about it and tried to convince them?

Colonel MCDONALD. We continued to forward requirements on a frequent basis which reflect changes in the actual——

Senator MALONE. Are you responsible yourself for bringing this quality up in manufacture?

Colonel MCDONALD. In a sense yes, sir, we are responsible. I intend to get into some of the work in my testimony. We are trying to overcome some of the manufacturing problems in forging it and extruding it and welding it.

Senator MALONE. What do you do on everything you order in National Defense? Do you say to someone, "Now, I will only order 10 percent of what I want, because I do not think you can do it," or do you order what you want, and if they are willing to take the contract to do it, do you give it to them and cancel it if they do not do it?

Colonel MCDONALD. That is the way we operate.

Senator MALONE. This time you seem to be operating backward. You assume they cannot do it, so you cut down your requirements. But I think what I am getting at, I think the committee is very much interested in finding out exactly where the logs are jammed.

We have testimony from every plane manufacturer, every engine manufacturer, that you need at least 150,000 tons a year of the good-quality stuff, but when you order it we have someone like you saying we do not think you can do it, so we will not order it.

Colonel MCDONALD. Sir, if you will recall, the estimates of 150,000 tons, which we concur in entirely, were based on one qualification. That is, that they had the quality of materials they wanted.

Senator MALONE. Why don't you make some contracts that will call for the kind of material you want?

Colonel MCDONALD. That, sir, is not our prerogative.

Senator MALONE. You are up a blind alley?

Colonel MCDONALD. Yes.

Senator MALONE. Here is a man representing that outfit, General Services Administration, that will make any contracts he is asked to make by the Defense Mobilization Administration.

Colonel MCDONALD. Yes.

Senator MALONE. You have no doubt about that, do you?

Colonel MCDONALD. No, sir.

Senator MALONE. Well, then, are you unable to get by the Defense Mobilization Administration with your orders?

Colonel MCDONALD. That was the case at the time the 35,000 tons was requested.

Senator MALONE. Suppose you are out in Wright Field—I have been in Wright Field and have looked over your work during World War II as consultant to the Senate Military Affairs Committee; you have a great organization out there—how are they going to know in the Office of Defense Mobilization if you only order 35,000 tons? How are they going to know you need 150,000 tons unless you tell them?

Colonel MCDONALD. Sir, I think that is a question of timing; 150,000 tons is a requirement.

Senator MALONE. You need it now; you needed it last year. What are you waiting for?

Colonel MCDONALD. I am waiting for the manufacturers to agree to incorporate this material into their airframes.

Senator MALONE. I can get you a man very quickly who, if you will get him the material, will incorporate it into the plane. I should have had him here as a witness. We will have him in Washington and you, too, so there will be no crossup.

Colonel MCDONALD. May I go into some of the details on how the requirements are computed?

Senator MALONE. Yes.

Colonel MCDONALD. They are done entirely on submissions from the Douglas Aircraft Co., Boeing, and so forth. We do not change them. They are the figures they give to us. We merely act as a collecting agency for those requirements and they are submitted directly to us by our contractors.

Senator MALONE. Are you familiar with the testimony of Donald Douglas himself that they cannot take these planes off the drafting board until you get this titanium for them?

Colonel MCDONALD. Yes.

Senator MALONE. Why don't you get it?

Colonel MCDONALD. I am also——

Senator MALONE. You say you want the order from them?

Colonel MCDONALD. Yes, sir.

Senator MALONE. You have the order from them in testimony.

Colonel MCDONALD. No, sir; not the formal requirements.

Senator MALONE. What do they have to do, write you a love letter about it?

Colonel MCDONALD. No, sir. Their requirements that they give to us are based on the assumption of materials they will be able to get today, next year, and the next 2 or 3 years.

Senator MALONE. Why aren't they able to get them? Because there is no authorization for contract?

Colonel MCDONALD. The quantities could be gotten but not the quality they would use.

Senator MALONE. I do not agree with you because here are people going to testify today that the sponge is the quality.

Colonel MCDONALD. Yes, sir.

Senator MALONE. I will get you the witness and should have had him here today. Hurley, of Curtiss-Wright, that knows how to use it.

Colonel MCDONALD. Yes, sir.

Senator MALONE. He can use it as soon as he has materials that will stand up under test.

Colonel MCDONALD. To date it has not been.

Senator MALONE. That is not his testimony.

Colonel MCDONALD. Part of the requirements we submit are based on what Mr. Hurley, of Curtiss-Wright, submits to us.

Senator MALONE. What has he submitted to you?

Colonel MCDONALD. I do not have the exact figures.

Senator MALONE. Here is just one remark and I have not time to review all of his testimony:

We added up to be 108,000 tons annually just for engines and auxiliary parts.

Colonel MCDONALD. That is right.

Senator MALONE. Then General Metzger says:

If Mr. Hurley's estimates stand up, I do not think we would buy engines unless we had airframes to put them in in the quantity you are talking about.

Douglas makes the airframes and cannot get it to make airframes out of. Now I say there, this is testimony taken last year:

Suppose the material were available. All you would need to do is forget availability of the material and defense and make airframes and engines you need and then his testimony would stand up.

METZGER. Yes.

We say you would be talking about 200,000 tons of titanium in 1956.

Colonel MCDONALD. Yes, sir.

Senator MALONE. You are still talking about 35,000 tons.

Colonel MCDONALD. Again, Senator, I can only reiterate it is a question of quality. Right now the airframe people are not utilizing sponge production that is available at present.

Senator MALONE. I cannot reconcile your testimony, with an order for the amount of titanium and alloys and specifications you need and somebody refusing or unable to give it to you. You have never given an order.

Colonel MCDONALD. We have never had that demand presented to us.

Senator MALONE. I am exhibiting it to you now. Do you want to go down with me next week and visit Douglas and call another hearing?

Colonel MCDONALD. I would be glad to, sir, at your convenience.

Senator MALONE. I will tell you what you would find out, he would tell you that you need 150,000 tons of titanium for airframes and engines to make the planes you want. I suppose you want them.

Colonel MCDONALD. We certainly do. It is our primary interest.

Senator MALONE. I cannot connect your testimony to an effort to get it. What you are doing is first saying you cannot make it so we

will not order it; and the 35,000 tons is the most you have ever ordered.

Colonel McDONALD. Yes, sir; based on requirements——

Senator MALONE. Only recently has the defense mobilization administration come up to the 35,000. Rumor around Washington is—it is a great place for rumor—you had too much titanium. We called a hearing again and established the fact you had too much titanium was because you did not have enough for anybody to start using it.

Colonel McDONALD. That and the quality problem.

Senator MALONE. That is right but you have not contracted for it and have not even ordered it with the specifications for a higher quality.

What I am trying to get at is: What is holding you back? Ordering what you want and laying down the specifications and letting the people who are experimenting with it and who know how to do it find out how to fill your order?

Colonel McDONALD. We have done it with all airframe and engine people. We are willing to support them financially——

Senator MALONE. Air frame people do not manufacture titanium.

Colonel McDONALD. I had not finished. We are willing to support them financially to any extent they, the contractors, are willing to go to incorporate titanium.

Senator MALONE. You cannot do that unless you have titanium and you have not ordered the titanium.

Colonel McDONALD. We would transmit our requirements based on what we get from the contractors.

Senator MALONE. Why don't you just order it and let the contractors worry about it?

Colonel McDONALD. Because that is not what they give us in terms of firm requirements for metal.

Senator MALONE. Who?

Colonel McDONALD. The contractors.

Senator MALONE. Now you are talking about contractors for what?

Colonel McDONALD. Our airframe and engine——

Senator MALONE. Do you think you would have trouble in getting contracts for the metal itself if you had it available?

Colonel McDONALD. No, sir.

Senator MALONE. Why don't you order the metal?

Colonel McDONALD. Quality again, sir; it is the quality.

Senator MALONE. Why don't you let the fellow worry about the quality that is going to make it and you worry about specifications?

Colonel McDONALD. I feel that we in the Air Force have to worry about quality because it is lack of quality that is preventing the material from getting into the airframes and engines.

Senator MALONE. You have not ordered it yet?

Colonel McDONALD. We do not order it. Our contractors, airframe and engine people, have not placed orders.

Senator MALONE. They do not order direct, they order it through you?

Colonel McDONALD. They do not, no.

Senator MALONE. They order it direct from the manufacturer?

Colonel McDONALD. Yes.

Senator MALONE. What do you have to do with it? Maybe I am talking to the wrong man.

Colonel McDONALD. With respect to the generation of requirements we are a collection agency. Our requirements for this material are gotten from the Douglas and Boeings and Pratt & Whitneys and North Americans.

Senator MALONE. You transmit it to the manufacturer?

Colonel McDONALD. We transmit it to the Department of Defense.

Senator MALONE. Nobody knows what happens to anything after it goes to Washington. It took this committee 6 months to find it.

Colonel McDONALD. Those requirements which we submit are consolidated at the Department of Defense level and submitted to the Office of Defense Mobilization.

Senator MALONE. We have got that. We are past that. That is 35,000 tons.

Colonel McDONALD. Yes.

Senator MALONE. That is not what you need. You need 150,000 tons, you said.

Colonel McDONALD. Sir, if we can get the quality——

Senator MALONE. Look, if I am building a bridge—and I have built a few of them—I do not go to try to figure out how to manufacture the cement. I order the quality I want.

Then if they cannot deliver it, we try to change the specifications on the bridge. But give them a chance to deliver.

Colonel McDONALD. We are much in the same position.

Senator MALONE. You are not ordering it.

Colonel McDONALD. We are ordering our equipment on the basis of performance specifications. We ask our contractors to provide us with certain performance. They are the people who do the engineering and set the specifications.

Senator MALONE. They have the planes on the drafting boards. They told us that. They cannot take them off until you get the titanium and you are holding the amount down that you order. Let the fellows that are manufacturing the alloys out of this titanium and manufacturing titanium worry about the quality. You cannot do all this worrying yourself.

Colonel McDONALD. That is right.

Again we are not holding down the quantity; we are reporting exactly what is collected from our contractors, the same people you refer to.

Senator MALONE. I think I am going to have to take another course in something, because I do not understand you.

Colonel McDONALD. I think the confusion here—if I may for a few minutes—I think the confusion arises from the fact that the 150,000-ton figure in which everybody concurs, including myself, Air Force, and everybody connected——

Senator MALONE. That you need for manufacture of planes in national defense, fighters, bombers, and interceptors.

Colonel McDONALD. Yes, sir; that estimate was based on not only availability of material but quality.

Senator MALONE. That estimate was not based on availability of material, it was based on what you need. We knew it was not available.

Colonel McDONALD. But, sir, that is what caused the difference between that figure where there is no reservation with respect to the quality or availability of material. That was the criteria on which

that figure was based. When you come to actual facts and we ask these people to tell us how much titanium they will use in the next 5 years, it does not add up to 150,000 tons a year.

Senator MALONE. Do you know why it does not? It is because you cannot show them where they can get it and they do not dare take the planes off the drafting board. Who is responsible for getting it and who is responsible for holding it up? We may not find out from you but we are going to find out and you will be called again.

Colonel MCDONALD. We are perfectly willing to do anything within the power authorized by the Department.

Senator MALONE. What are you authorized to do?

Colonel MCDONALD. Only to collect and present to the Department of Defense our requirements for materials.

Senator MALONE. What are they? Forget availability of it. What is your requirement?

Colonel MCDONALD. I can only go back to the figures which are submitted by the contractors in whom we have the utmost faith.

Senator MALONE. Who are the contractors?

Colonel MCDONALD. Airframe and engine contractors, the people we buy from.

Senator MALONE. Douglas, Lockheed, Curtiss-Wright?

Colonel MCDONALD. Yes, sir.

Senator MALONE. They are clearly beyond you. You say they do not order it. The reason they do not order it is because they know you have not got it.

Colonel MCDONALD. Senator, perhaps this would clarify it. They not only do not order it, they have actually canceled orders. It is not a question of not being sure of the availability of supply.

Senator MALONE. You mean the testimony is wrong in that they do not need it?

Colonel MCDONALD. It is a question of interpretation. They cannot use any of that material if it is not up to the quality and standards they specify. We do not specify it.

Senator MALONE. My friend, it could be I cannot understand the English language. What we have here is evidence that these people want a certain specification to build their planes and need 150,000 tons for the engines and frames. You are standing out there at Wright Field and telling them that this is not available, it cannot be made, and it cannot be used there so it is not available to them and they have to cancel the order.

Colonel MCDONALD. No, sir; that is not it.

Senator MALONE. What part of this do you play?

Start from the beginning.

I think this committee is wasting its time with you right now.

Colonel MCDONALD. The way these requirements are determined, as I explained a moment ago, is based entirely on submissions from our contractors—we do no screening or altering of the figures they submit to us.

Senator MALONE. Who submits?

Colonel MCDONALD. The airframe and engine people, Douglas, Boeing, and so forth.

Senator MALONE. Have they ever told you that they need much more than you are supplying them?

Have they ever told you that if they had it available in proper specifications, they could use 150,000 tons?

Does it add up to that?

Colonel McDONALD. Yes, sir.

Senator MALONE. Well, then, what I am trying to find out is who is responsible for making this material and making it add up to the specifications?

In other words, the alloys. We know everything is new at some time. Aluminum was new. Aluminum alloys did not stand up. Nothing stood up. But they did not throw aluminum away and say, "We don't need a certain amount." They tried to find out how to make it meet the specifications and order the amount they wanted. You are telling me here today that because you know they cannot meet these specifications, you will not order it. You will not put in an order for it.

Colonel McDONALD. No, sir; because Boeing and Douglas and North American know they cannot meet specifications. We do not establish them.

Senator MALONE. They know you cannot meet specifications?

Colonel McDONALD. The suppliers of material.

Senator MALONE. All right. What I am trying to say is why don't you tell—you are responsible to Wilson; aren't you?

Colonel McDONALD. Yes, sir.

Senator MALONE. He is supposed to take what you say and order the amount you say you want.

Colonel McDONALD. Correct.

Senator MALONE. Why don't you order the amount you want and write the specifications for it, give it to Wilson so he can give it to the Office of Defense Mobilization, and they can give it in turn to the GSA, and then you have got somebody to hold responsible for lack of meeting the specifications. Then you could come in here and say, or some other committee who is interested in it, any say, We have ordered this material but they can't meet specifications. They are trying to. Wouldn't you like to be able to say that?

Colonel McDONALD. Yes, very much.

Senator MALONE. Why don't you order it and see what happens?

Colonel McDONALD. Sir, we cannot order material.

Senator MALONE. What do you do?

Colonel McDONALD. Boeing and Douglas, our contractors—they order the material.

Senator MALONE. We know they want it. You have to tell Wilson how much ought to be used in these planes that you want; isn't that it?

Colonel McDONALD. Sir, we can only go on the advice of the experts, the Boeing and Douglas people, as to how much they can use. We cannot tell them how much to use.

Senator MALONE. I am just going to have to take a vacation. I have worked too long. I just cannot understand you. Can you, Senator Brown?

Senator BROWN. I came in rather late, Senator.

Senator MALONE. You seem to be the bottleneck right there in Wright Field?

Colonel McDONALD. No, sir.

Senator MALONE. I think you are. I think I have found it.

Colonel MCDONALD. The same figures were submitted when my predecessor was in office.

Senator MALONE. Your predecessor said he wanted 150,000 tons?

Colonel MCDONALD. I am sorry if I have not made myself clear. I want 150,000 tons. I think perhaps the future of this industry would outstrip the stainless-steel industry, where you are talking about a million tons a year.

Senator MALONE. You will find that in the report, too.

Colonel MCDONALD. Yes, sir; I firmly believe in that. We cannot represent to the Department of Defense or to the Office of Defense Mobilization that we need an amount of material which is unrealistic, and we only base our estimates——

Senator MALONE. It is all unrealistic before you order any.

Colonel MCDONALD. Sir, I think we have been very instrumental in trying to encourage our contractors to use this material, but we cannot order them to do it if it results in an airplane that will not perform.

Senator MALONE. Start over. Rub it all out and play like you are starting again.

Can you at Wright Field determine your need and request the head of the National Defense Administration to get it for you?

Colonel MCDONALD. Yes, sir.

Senator MALONE. What do you do? I have been wrong there. I thought I understood you to say you are the one who said Wright Field is where the head of the National Defense Administration gets his amounts of requirements.

Colonel MCDONALD. We get the requirements, but we do not place orders with the suppliers.

Senator MALONE. I said could you send in your requirements to the head of the National Defense Administration?

Colonel MCDONALD. Yes, sir; we do.

Senator MALONE. What have you sent?

Colonel MCDONALD. Exactly what we have received from Douglas, Boeing, North American, and so forth.

Senator MALONE. Now we are back where we started from in the swamp. Let us say now that you forget we have any plane manufacturers; just forget them, and it is all up to you. You are starting all new. You want a certain number of planes, bombers, and fighters, and interceptors, and it is up to you to determine and help the Administrator, Wilson, to determine how much he is going to request of this material and the specifications for it.

Let us wipe it all out. Get it all out of your mind. What kind of a letter would you write him?

Colonel MCDONALD. I think in that position I would take a rather calculated risk and ask for the kind of figures you have reference to in the book. We ought to have production capacity for something in that neighborhood.

Senator MALONE. 150,000 tons of a certain specification and make it explicit. He would have something to operate on. Couldn't he then call up Mr. Flemming if he did not have time to write a letter, and say, Doctor, here I am sending down to you the specifications and amounts we need? Couldn't you do that?

Colonel McDONALD. We could do that.

Senator MALONE. Then after that Dr. Fleming, if he did not have time to write a letter, could call Mr. Mansure, whom I know very well, and I think is trying to do a fine job but cannot go beyond the order of the Office of Defense Mobilization. Then Dr. Fleming, having all of his trail covered, he can say, if somebody said that is going to cost too much money—maybe Congress might say it—he will say, "Call Director Wilson." Director Wilson reiterates what you wrote to him—and you are supposed to know your business. Congress then—I am supposing as 1 of 96 Senators—have been trying to get this information for a long time and they will. I say without fear of contradiction, appropriate all the money you need, and I think it is available anyway. All they have to do is order it and they are able to sell the bonds and get it. It is already authorized. All right. Now we are up to Fleming. Fleming goes to GSA. GSA lets the contracts. And when you get it, Mr. Douglas and Mr. Gross would use it, wouldn't they?

Colonel McDONALD. Not for the next several years, sir. That capacity would have to be stockpiled someplace.

Senator MALONE. Well, that is not what they told me, and it is not their testimony for your information. If they had it, had it tomorrow, they would use it as soon as they could get these planes off the drafting boards, but they do not dare take them off.

Colonel McDONALD. Taking them off the drafting board doesn't mean production before 4 or 5 or 6 years.

Senator MALONE. It does. But you are going to wait 5 or 6 years to get them off the drafting board.

Colonel McDONALD. No, sir; we would phase the requirements of titanium into requirements for use.

Senator MALONE. I recommend to you that you get a set of specifications that have come out from the Curtiss-Wright engine people.

Colonel McDONALD. I have that book.

Senator MALONE. Do you understand what you are talking about as to what they will do which is to take this titanium and put it in one piece at a time in that engine just as fast as it is available?

Colonel McDONALD. Yes, sir.

Senator MALONE. Does that mean 5 or 6 years to you?

Colonel McDONALD. No, sir; I was talking about Mr. Douglas and Mr. Boeing and the airframe people.

Senator MALONE. I am talking about them, too, and they said they could take these pieces and put them in the frame as fast as they could get the material.

Colonel McDONALD. The requirements which they submitted and which we transmitted incorporate——

Senator MALONE. We are back in the swamp. You are talking to the people that cannot get it. You are the man that we have established now according to your own testimony is responsible for getting it. You are going back and saying they cannot use it because they cannot get it.

Colonel McDONALD. No, sir; our planning goes to using titanium in the Wright Aeronautical Co.'s engines. We are making every provision to see he gets all material he wants for that engine. We have under consideration——

Senator MALONE. You have made that provision?

Colonel McDONALD. Yes, sir; and we have also——

Senator MALONE. That is not what he says. We will have his testimony in Washington. He just cannot get it because you are not ordering it and you are not following through. So you are sitting out in Wright Field and you will not order it because they are not able to use it right at the moment, and they cannot get it until you order it.

Colonel McDONALD. Sir, part of what we ordered, or the requirements we submitted, include Mr. Hurley's requirements for the engine in the same study you have reference to.

Senator MALONE. Well, look, 35,000 tons does not cover it.

Colonel McDONALD. Sir, I do not quite follow that figure because we do not have any plan for procuring engines from Wright that will include that amount.

Senator MALONE. Then 35,000 tons including all titanium for every purpose you have ordered?

Colonel McDONALD. Yes.

Senator MALONE. Do you think that is enough?

Colonel McDONALD. I do not think it is enough, sir, in the future. As for our immediate requirements——

Senator MALONE. We are talking about the future and the reason it is enough for immedaite requirements is nobody can get enough to put in the engine or frame, either. I guess you are the bottleneck.

Colonel McDONALD. No, sir. We are willing to do anything we can to get anything that the contractors want.

Senator MALONE. Why don't you order it?

Colonel McDONALD. Because they have not transmitted to us their desire to order it, Senator.

Senator MALONE. I guess I could have them all out there next week if you have to have it word of mouth.

Colonel McDONALD. I would advise that. It might clear the air. Apparently there is a difference of interpretation on the figures they have submitted which I feel are entirely valid once they get the quality of material.

Senator MALONE. Do you have any questions, Senator Brown?

Senator BROWN. No, Mr. Chairman.

(At 12:20 p. m. the hearing was recessed until 2 p. m.)

AFTERNOON SESSION

Senator MALONE. Come to order. I want to say at the outset we are all here for one purpose, and if it does not inconvenience anyone and it looks like we might finish tomorrow noon and make it handier for people to get away, we may hold over for a hearing this evening.

We will decide later in the afternoon. Anyone who will be inconvenienced, if we have a hearing tonight, can let the chairman know.

Mr. Edwin A. Harris, Light Metals Division, Office of Defense Mobilization, Washington, D. C.

Mr. Harris, we are glad to see you here. This committee, as far as titanium is concerned, titanium is just 1 more metal in the 77 critical materials, but it is a very important metal in that its weight-strength ratio and heat-resistant qualities and corrosion qualities are unequaled by any metal so far described or known about that is in general use.

Also, it is generally known that the raw material that goes into the manufacture of titanium, some say, is fourth, fifth, or sixth most plentiful in the earth's surface.

At least we know there is plenty of the raw material in the United States and Canada and adjacent countries to manufacture all the titanium we want. If it is what it now appears to be, then, as this report and conclusions of the committee outline, there is a tremendous supply in the offing, civilian as well as national defense.

The objective then, as outlined in this report, seems to be like any other material, like stainless steel, like aluminum, nurse it along, until the production is above the amount needed for national defense, and then that takes it out of the critical stage. In other words, aluminum is not a critical metal now, though it is very important to national defense. Neither is stainless steel, because there is such a terrific industry in both metals. We are looking forward in the not too far distant future when titanium will be in the same position.

It has only been a few short years ago when aluminum was worth $40 or $50 a pound, and there were no aluminum alloys that were worth anything, but when you know what you want and know the amount you need, and there is money to pay for it in a defense manner, you get it. That is the history of all metals.

Mr. Harris, you heard the testimony this morning. What the committee is trying to find out again—I think we found out in 1953 and 1954, as outlined in Senate Report 1627, where the bottleneck was on most of the critical materials.

Now, since the Senate recessed we again hear a revival of this talk of too much titanium, and you cannot order the production of titanium until the manufacturers of planes order it, and they cannot order it until they get the quality of material.

We come back to the same mire and mudhole every time. We want to know where the logs are jammed. We have traced it from Wright Field this morning to the National Defense Administration to the Defense Mobilization Administration to the GSA. If you can give us a little light on this subject, just in your own way, if you have a prepared statement or if you do not, just give us whatever you can.

STATEMENT OF EDWIN A. HARRIS, LIGHT METALS DIVISION, OFFICE OF DEFENSE MOBILIZATION, WASHINGTON, D. C.

Mr. HARRIS. Perhaps I should identify myself for the record.

My name is Edwin A. Harris, Chief of the Light Metals Division of the Office of Defense Mobilization.

May I say also at this time, Senator, that I think the results of this morning have once again proven, as far as we are concerned, the value in the hearings that you have been conducting over a period of months in connection with developments in the expansion of the titanium industry.

HOW EXPANSION OF TITANIUM INDUSTRY IS DETERMINED

Getting back to what I think is your specific question as to where the Office of Defense Mobilization fits into this whole question of determining the rate of expansion of the titanium industry, our func-

tion as I see it is precisely this: Whether it is titanium or aluminum or any strategic material, we get through the Office of the Secretary of Defense estimates of the amounts of materials—these strategic materials we are talking about—which they feel are necessary to wage a successful war.

Senator MALONE. That is a program of year-to-year needs?

Mr. HARRIS. That is correct. We get at the same time from the Department of Commerce an estimate of the amount of material which will be needed to maintain a strong civilian economy in a period of war. We combine those two figures into a set of what we call total or full mobilization requirements. Our job then gets to be the establishment or the development of a program of supply, generally speaking, to meet these needs, broken into 2 pieces—that is, a development of a productive industry in being, plus, perhaps, a reserve in the form of a stockpile, the sum of the 2 being sufficient to provide these requirements in the amounts needed and on time.

Now in the case of titanium, the procedure has been precisely the same. We have now received—as a matter of fact about 5 weeks ago—for the first time from the Office of the Secretary of Defense their estimates of what it would take to fight an all-out war in terms of tons of titanium.

At the same time we have from the Department of Commerce their estimates of what the civilian industry would require. We are right now in the process, Senator, of developing an expansion program, a combination expansion and stockpile program designed to meet those requirements.

Senator MALONE. Would you mind giving us the figures that you have received from the National Defense Administration and from the Department of Commerce?

Mr. HARRIS. I am very sorry, Senator, those are classified secret. I am looking forward to the time we can reconvene in Washington and make them available to you in executive session.

Senator MALONE. That will be very helpful. Could you, without violating any classified information, give us an idea if it has increased over the present demands.

Mr. HARRIS. Very much so.

Senator MALONE. I think we are getting somewhere now. Continue to make your statement in your own way to complete it.

Mr. HARRIS. Those requirements have been presented to the Kellogg committee.

May I say now the Kellogg committee is very much in action at the present time.

Senator MALONE. Is Dr. Kellogg still chairman?

Mr. HARRIS. Yes, sir. Dr. Kellogg was slated to appear before your committee today, Senator, but frankly, it just happens to be a very bad day for him in view of his responsibilities at Columbia and I am pinch-hitting for him but he will be available to you back in Washington.

Senator MALONE. We are glad you could come and we will have both of you in Washington.

Mr. HARRIS. The Kellogg committee met a week ago yesterday for the first look at these figures, new industrial civilian figures and new national-defense figures, to get their first grasp, you might say, of the magnitude of the job ahead of us. My office has since been doing some

staff work on those figures as a result of the recommendations of that committee. That staff work is complete, and the committee is meeting again this coming Tuesday. Give us another 2 weeks and I think we will have a lot more specific information.

Senator MALONE. That is about the time we will be there.

Mr. HARRIS. Again it will have to be executive session but I think we will be prepared pretty well at that time to run over this whole problem for you.

Senator MALONE. We will arrange it for you.

Mr. HARRIS. That is just about where we stand at the present time.

Senator MALONE. Now let me ask you just for the purpose of keeping the record straight and again reminding you that you will have this testimony to correct for completeness and correctness, because this committee certainly does not want to embarrass anyone with any statement they might inadvertently make in testifying without a written statement.

Now, I am going to ask you then where this thing starts, where it originates. As far as you are concerned, are you able to direct an organization such as the GSA either to purchase or to contract for national defense critical materials based on an order or an estimate from the National Defense Administration?

Mr. HARRIS. I wonder if I might answer that in this way. Going back to the time Dr. Flemming appeared before your committee, I think the particular session of January 28, as I recall, he stated at that time that it was fairly obvious on the surface that the figure that we had been working with up to that time—that is, the 25,000-ton figure—was not realistic. Therefore, in effect, what he did was to remove that as a ceiling.

He said this 25,000 tons is not realistic. Let us forget it. At the same time he instructed the General Services Administration to proceed to negotiate in good faith with all those that they could persuade or convince to get into this titanium business. General Services Administration has been proceeding as rapidly as they could in the negotiation of those contracts.

Senator MALONE. With no limit?

Mr. HARRIS. No limit. May I explain that, Senator?

Deliberately it was stated there was no limit at that time although I am quite certain Dr. Flemming testified then that that situation would pertain until such time as we did get from the Department of Defense a specific delineation of precisely what they thought they needed to fight a successful war.

Senator MALONE. Amount they needed and the specifications?

Mr. HARRIS. We are just talking amounts at the present time.

Senator MALONE. But they would have to furnish you specifications, too; would they not?

Mr. HARRIS. That is correct. Now that information was made available just about 4 to 6 weeks ago. We now have the information, you might say, to determine up to what point we should authorize the General Services Administration to go in order to meet these requirements. As soon as the Kellogg Committee has completed its study of these figures it will submit to Dr. Flemming its recommendation as to what the Government's program should be. Then it is up to Dr. Flemming to implement that at that particular level.

Senator MALONE. There is no reason you know of that Dr. Flemming would see fit to reduce any estimates that the Defense Administration gave him in good faith?

Mr. HARRIS. Senator, we have absolutely no basis on which to reduce the figures that come to us from the Department of Defense. They are the ones that have the responsibility for defending the country. Far be it from us to tell them they should get by with less.

Senator MALONE. Where they get their figures is their business?

Mr. HARRIS. That is correct.

Senator MALONE. If they get it from Wright Field or Reno or San Francisco or Alaska, that makes no difference to you. That is their responsibility.

Mr. HARRIS. That is right. When the Secretary of Defense tells us this is what I have to have, that becomes our program.

Senator MALONE. You assume he has consulted the people that know how to make these planes, that he has in his national defense administration at Wright Field and elsewhere, that know what planes they need, how fast they have to fly, what the range has to be, and then they work it so they know what they have to be made out of, what metal is necessary. You assume they have gone through that and cooperated with the plane manufacturers like Douglas, Lockheed, and all the rest.

Mr. HARRIS. We presume the Secretary of Defense knows what it will take in the way of total tonnage of materials to fight a successful war.

Senator MALONE. Then apparently if you have received these figures, we will go into that later as to the amount, the roadblock has been sort of removed at the present time, it is coming through.

Mr. HARRIS. That is right. I can assure you, Senator, that on the basis of the figures now available to us without referring directly to their magnitude, there is ample room for all the work that we can squeeze out of the General Services Administration for some time to come and in the meantime we can continue to study this and develop the refinements of some of the details of the requirement figures.

Senator MALONE. The subcommittee was impressed, I think, speaking for the chairman anyway, that you were dealing with people who were capable of doing their jobs. In other words, you were not picking up people who did not know, did not have any background or did not have the roots down some place on a formula or procedure to make it, that you were dealing with substantial organizations like the Union Carbide Co., Kennecott Copper Co., Monsanto Chemical Co., and others that have a reputation, have established a reputation over the past 2 or 3 decades that they have the personnel and equipment and when they start a job they generally finish it.

The committee was impressed with the fact that you were in touch with these people.

Now, without trying to get any information that you cannot make public, Colonel McDonald testified this morning he is one of the workingmen out there and I have every sympathy in the world for a man who is just in a place where he has to do a job.

You are familiar with the figures that the committee came up with after Mr. Douglas, of Douglas Aircraft; Gross, of Lockheed, and 4 or 5 other large manufacturing companies; and Hurley, of the Curtiss-Wright Engine Co., and Pratt-Whitney representatives and sev-

eral others, after they had all added this up, we come up with a requirement of something in the neighborhood of 150,000 tons of titanium annually. That if it were available in the proper specifications and the companies could depend on such supply that was the amount that was needed for defense.

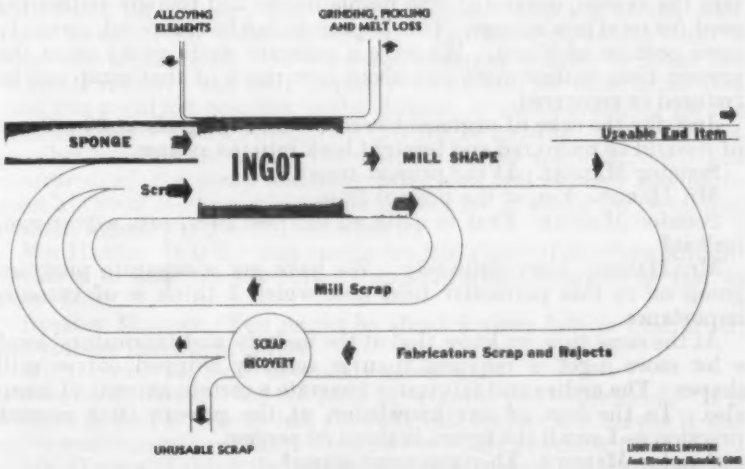
You heard General Metzger's testimony last year, you have read the testimony of these other men, you heard Colonel McDonald say this morning he agreed with that.

Is there any reason to suppose that the conclusions will be very much different?

Mr. HARRIS. I have a chart over here, Senator, that I think throws a little light on this, perhaps. With your permission, I would like to show it to you.

Senator MALONE. Yes.

FLOW CHART FOR UTILIZATION OF TITANIUM



Mr. HARRIS. It might help to get at the problem.

This is a chart of the utilization of titanium we put together for illustrative purposes, bearing in mind that the problem we have is the determination of the amounts of sponge that have to be injected into the titanium system to meet these so-called full mobilization requirements.

The form in which the information comes to us through the Department of Defense and the form in which I believe Colonel McDonald gets his information is in the total requirements of mill shapes—so many tons of forgings, sheets, rolled bars, so many tons of extrusions. That makes up a product mix, or you might say a pattern of what these requirements are.

The length of this bar here has no particular significance but the width of it does. Assuming that the full mobilization requirements given to us represent that width, which for the sake of argument we will say is 100, it appears——

Senator MALONE. 100 what?

Mr. HARRIS. Just a hundred units. Now let us say for the sake of argument that is 100. I can say this as far as the requirements are concerned, I think without violating security, that the preponderance of the requirements on a full mobilization basis as now stated is in the form of forgings.

I should say also that the forging information given us is in the form of total tons of rough weight of the forgings. That being so, and there being a certain amount of normal scrap generation at the aircraft fabricators' level, the actual tonnage of titanium that flies away here is quite substantially less than the total requirements of the aircraft and engine producers stated in tons of mill shapes.

This figure of scrap generation is probably about 70 percent. It seemed to us immediately that bearing in mind that our problem is to determine how much new sponge we have to get into the system it was equally important to determine first how much of this scrap that is generated at the fabricators' level could be recovered, put back into the system, converted into usable ingots and thereby reduce the need for total new sponge. This 70 percent can be recovered, certainly some portion of it can. We have a separate study going on at the present time to determine just about how much of that scrap can be restored or recovered.

Just for the sake of argument here we are saying about 60 percent of it could be recovered and brought back into the system.

Senator MALONE. At the present time?

Mr. HARRIS. Yes, at the present time.

Senator MALONE. That is quite an increase over, say, a year ago, isn't it?

Mr. HARRIS. Very definitely. We have got a separate program going on in this particular field now which I think is of extreme importance.

At the same time we know that at the melters' and fabricators' level a lot more ingot is required than is actually shipped out as mill shapes. The melter and fabricator generate a certain amount of scrap also. To the best of our knowledge, at the present time present practice, as I recall the figure, is about 30 percent.

Senator MALONE. Thirty percent scrap?

Mr. HARRIS. Yes. At the melters' and fabricators' level. They, of course, have some losses up here—grinding, pickling, melt losses. This is about 10 percent. Something in the neighborhood of 10 percent will be lost.

I think this titanium utilization analysis illustrated and brought out forcibly to the Kellogg committee the fact that in determining the amount of new sponge that has to be brought into the system, at the same time a very vigorous and aggressive scrap program is essential so that we can get the maximum utilization of the material produced.

Senator MALONE. I think, Mr. Harris, the testimony at the beginning of the hearings of this committee was that very little of the scrap was recoverable, but they had plans then for a continual increase and looked forward to the time where most of the scrap would be recovered and used like steel scrap and other scrap, but it was impossible to do it then.

I think my attention has been called to the fact that we had a year ago practically no scrap recovery.

Mr. HARRIS. That is right.

Senator MALONE. But every bit of the scrap recovery on percentage for that same percentage of usable end items adds that much or detracts that much from the amount of sponge that is necessary?

Mr. HARRIS. That is right.

Senator MALONE. Go ahead.

Mr. HARRIS. That, I think, is the whole story. My chief point is to point out that when we are talking requirement as submitted by the plane manufacturers we are talking of the thickness of this bar, mill shapes. It does not necessarily follow that the same figure has to come in in the form of sponge. That is my point.

Senator MALONE. I think that is clear to everybody, but on the other hand, I point out to you that with the chemical industry standing at the door waiting for the metal to use in its civilian industry and the commercial plane industry standing at the door to use it, and with the milk industry and other industries standing at the door ready to use it for different reasons. The strength-weight ratio is what the planes want, the corrosion-resistant quality is what the chemical industry and milk industry wants, but for these other reasons, you could not possibly, in the opinion, at least—speaking for the chairman after going through all this for 14 months—you could not possibly have too much titanium with the proper specifications if you recovered all the scrap suddenly after you had enough sponge to meet all your military requirements, because it would go right into civilian industry if you did not want it.

Mr. HARRIS. It is for that reason we told General Services Administration to keep the pressure on and negotiate contracts as fast as they could.

Senator MALONE. You might be about 2 years late in that order, but you are making progress.

Mr. HARRIS. We move as quickly as we can.

Senator MALONE. I am not blaming anyone, you understand. It is a question that somebody had to break this logjam and maybe it was up to some committee that did not owe anybody anything to do it.

Mr. HARRIS. I think the logjam has been broken. It is well on the rails and is moving rapidly.

Senator MALONE. Your testimony is very helpful in that regard and we will look forward to getting the definite figures so we are able to coordinate the work. Do you have a further statement?

Mr. HARRIS. I would like to clear up one point and that is, if I could elaborate for a moment on the Kellogg committee—I assured you before that the committee continues to operate and will continue to operate until we have the job well in hand.

Senator MALONE. We are tired seeing new men trained and have them drop in or have new committees come in over everybody else that does not know anything about it.

Mr. HARRIS. We have advisers serving regularly on that committee and attending each meeting. General Metzger was one of the advisers up to the time he retired. We have asked Mr. Talbott, Secretary of the Air Force, to name another Air Force delegate to serve as adviser of the committee.

Senator MALONE. Does that make General Metzger unavailable, the fact that he is out of the Army?

Mr. HARRIS. I am not certain.

Senator MALONE. As chairman, I am making no suggestions to you because I think General Metzger has proved his value on two counts: First, he knew what he was doing, showed a greater general knowledge of the requirements of the industry—that is, the requirements of the plane makers to make the planes according to specification needs by the Air Corps, requirements of the number of planes and amount of material needed by the Air Corps, and the fabricators' problems and the actual enginemakers' problems, probably a greater overall knowledge than anyone who appeared before the subcommittee. It seems that it would be a loss to the overall picture for a man like that to become unavailable but, of course, you are the one who has this responsibility and we are not making any suggestions to you if you have someone who can take his place.

Mr. HARRIS. We expect there will be. We have asked Secretary Talbott to name such a person.

Senator MALONE. Now will you tell me about this Quarles Committee, the Assistant Secretary of National Defense has set up and has some kind of a say in all this?

Mr. HARRIS. I would like to put it this way, if I may, having listened as an adviser to the Kellogg Committee, to the discussion of this particular subject.

It was stated to us that prior to the establishment of the Quarles Committee there existed in the armed services—that is, the Air Force, Army, and Navy—a whole host of committees and groups working on research and development contracts in the field of fabrication of titanium and the development of new use for titanium in end items.

Actually, the formation of the Quarles committee was an attempt then on the part of the Assistant Secretary of Defense for Research and Development to bring together about 11 committees, 11 or 12, and boil them into 1 coordinated committee.

Now, in so doing it was presented to the Kellogg committee that there are a whole series of problems in this question of research and development on titanium fabrication techniques. There is no question about it. Our group looked into the issue of who in Government is best qualified, best equipped, best set up to go forward and do that particular kind of work?

It was agreed that the Office of the Assistant Secretary of Defense for Research and Development did have those facilities. It was, therefore, the opinion of the Kellogg committee in which Dr. Flemming concurred, that under those circumstances Mr. Quarles should take over that particular function, that is, research and development on fabrication techniques and the fabrication problems—beyond the sponge stage in the titanium industry. We went so far at that time as to offer to support this particular program with financing under the Defense Production Act were it necessary. So far apparently the question of financing has not appeared to be a problem but we have stated, if you in the Department of Defense cannot swing this in your budget, we will be glad to take another look and see if there is a basis on which anything you cannot do can be financed under the Defense Production Act.

Senator MALONE. There is no limit under the Defense Production Act of money you can visualize in the foreseeable future, is there?

Mr. HARRIS. Not that I know of in terms of the type of development program generally contemplated in titanium fabrication problems.

Senator MALONE. Now what has the Quarles committee done or what are they going to do? What do they say they are going to do?

Mr. HARRIS. They are going to sponsor, finance, and service research and development contracts as rapidly as they can handle them in this great broad field of fabrication problems, fabrication techniques, development of alloys, problems of that nature.

Senator MALONE. Now they are not going to do this themselves, they are going to make contracts with competent firms.

Mr. HARRIS. That is right. It is not a Government function. They will merely farm out these jobs to whomever they feel is best qualified to do the work and make the information available soon.

Senator MALONE. We have heard considerable criticism, and for some time, that the Air Corps, the National Defense Administration, try to design a plane and then let the contract; whereas it is not the function of the Air Corps to design a plane at all. If the National Defense or Air Corps would lay down specifications as to what they want the plane to do, the objective—in other words, if they want a bomber that will fly 5,000 miles and distribute its bombs and come home without refueling and they want to carry a certain load, then they could say that to a plane company that knows how to design a plane, to do that and they will know the materials that have to go into it in certain proportions to make it stable and workable and usable and know a lot more about it than the Air Corps.

They do not know as much about what they want to use the plane for but they tell them what they want the plane to do and let the experts that know how to design a plane design it so it will cost less and be a lot better.

Now, let us get on to what this Quarles committee is about to do. They are going to set up an organization to let contracts to certain people to determine certain alloys that will do certain things.

Wouldn't it be better to write the specifications of what they want in a plane, a bomber, a fighter, an interceptor or whatever it is, and let the plane builders find out how to do it? Why do we need another research organization in there that simply is very likely to work as a further delay?

Mr. HARRIS. I am sure you intend to bring out on the basis of direct testimony from Secretary Quarles, or one of his assistants, precisely what they do.

Senator MALONE. That is right, but I say to you, you are the accessory after the fact and if the thing falls down it may not be your fault but you are in there with them. Maybe it is part of your business, after all.

Mr. HARRIS. We certainly will watch very closely the functioning of this committee. I think it is clear that what the Kellogg committee has recommended and what Dr. Flemming has accepted and agreed to, is the fact that in this broad area of research and development in fabrication techniques to the extent a Government program is required and Government assistance is required it is our feeling that that type of

activity can best be performed directly in the Office of the Secretary of Defense for Research and Development.

We, in the Office of Defense Mobilization, do not have a staff of technicians that could oversee that job.

Senator MALONE. Neither do they.

Mr. HARRIS. We are a small group. They have the closest thing to a corps of technicians in this field that exists in the executive agencies to the best of my knowledge.

It is my understanding that it is not their intention to do this work themselves. Their specific responsibility is to see where something must be done and to get somebody working on it, whether it is the Titanium Metals Corp., Allegheny Ludlum, whoever it may be, that somebody gets really at the problem and goes to work on developing a solution to it.

You have some of the best men in all the world in plane manufacture. They know how to test materials, they know how to use materials, they know who to go to to get tests made. My point is instead of the Government trying to go into the matter of how to make planes maybe it is better to use the plane manufacturers who have proved themselves for 25 or 30 years. If they say they want a bomber or fighter to do a certain job, a fighter to fly 1,500 miles an hour and stay in the air so many hours at certain speeds instead of their trying to hire designers and test materials, why don't they give the job to somebody that knows how to do it?

Mr. HARRIS. I see your point, and it is a very good one.

Senator MALONE. If I size the situation up right your committee can nullify anything if you want to that they order. Isn't that about right?

Mr. HARRIS. In certain fields, I would think that would be true. In the field of the development of materials or titanium as a material, I think that is true.

Senator MALONE. If they order so much titanium as they did, 35,000 tons, and you cut it to 22,500, you did nullify it, didn't you?

Mr. HARRIS. That is correct. That was, shall we say, unfortunate, but, nevertheless, it is the record.

Senator MALONE. There wasn't anybody else to overrule you, was there?

Mr. HARRIS. That is correct.

Senator MALONE. You could be a very valuable committee, and you can be a very dangerous one.

Mr. HARRIS. This committee is doing its utmost, I can assure you, to be just that, a very valuable committee.

Senator MALONE. I know you are.

If, through Wright Field and all the other experimental fields, the information finally comes to Wilson and his staff that they need a certain number of planes and a certain percentage of titanium, and they specified the number of these planes they needed to do a job, and then they got the Douglas Aircraft and Lockheed and the rest to tell them exactly what they needed in this material, and that was laid down on your desk, you would feel better about it, would you not?

Mr. HARRIS. That would be straight from the horse's mouth.

Senator MALONE. You would not have 3 or 4 barns to go look for the horse.

Mr. HARRIS. Just the mouth I was looking for.

Senator MALONE. I think your testimony is very valuable here today. We are just trying to develop how to get this thing coordinated again.

You have no reason to question what the National Defense Organization tells you they need?

Mr. HARRIS. That is correct.

Senator MALONE. As far as the metals are concerned.

Mr. HARRIS. That is correct.

Senator MALONE. Now we have about four committees mixed up in this thing. The Department of Commerce determines the civilian needs; is that right?

Mr. HARRIS. Yes.

Senator MALONE. They furnish you that amount of material as far as titanium is concerned, an estimate of the amount they need in civilian work?

Mr. HARRIS. That is correct.

Senator MALONE. They have done that?

Mr. HARRIS. That is correct.

Senator MALONE. As well as this new estimate from the National Defense Administration?

Mr. HARRIS. Yes.

Senator MALONE. Well, I think we will call the Department of Defense when we get to Washington as well as the Defense Administration and your organization perhaps in executive session for the three of you, that would be very helpful.

Mr. HARRIS. I think it would make a lot of these things quite clear, Senator.

Senator MALONE. Do you have anything further?

Mr. HARRIS. No, sir.

Senator MALONE. Well, we are very appreciative, Mr. Harris, that you have come before us here and if you will advise Mr. Flemming that we appreciate your presence here.

Mr. HARRIS. All right, sir.

Senator MALONE. Thank you.

Colonel McDonald.

STATEMENT OF COL. HENRY G. McDONALD—Resumed

Colonel McDonald, I am sorry we did not come out with a little better conclusion this morning than we did, but you heard the testimony of Mr. Harris that the Defense Administration has, as a matter of fact, come up with a new estimate of the amount of titanium that they will need for national defense?

ESTIMATE OF TITANIUM NEEDED FOR NATIONAL DEFENSE

Colonel MCDONALD. Yes, sir, under mobilization, all-out war.

Senator MALONE. Now, I do not understand that that had to be based on orders already received from plane makers. It is something that your National Defense Administration has estimated with the information that they have of the amount of titanium they need in each plane and now they have given it to the Office of Defense Mobilization which is now in the process of reviewing those estimates and will in a

short time pass them on to the GSA or wherever it is necessary to secure the amount.

Now would you like to explain again how this thing has worked out from your standpoint?

Colonel McDONALD. Yes, sir. These requirements are based on two things: The usage per unit airplane, multiplied out by the schedules, number of airplanes to be purchased.

Senator MALONE. We established, I think, that 25 to 40 percent titanium is generally considered according to the type of plane and availability of metal necessary to make it a first-class fighting plane.

Colonel McDONALD. Because of that factor of numbers of airplanes we are buying comes the wide variation in titanium requirements to meet current procurement which is at a much lower rate of production than if we went to full mobilization under which the schedules and numbers of airplanes would be manifold times current.

Senator MALONE. Isn't it full mobilization you are concerned with?

In other words, the only way you are going to keep out of trouble a good many people think, including the chairman of this committee, is to have available enough equipment to top any other nations' equipment so that they know they could not win.

Colonel McDONALD. That is correct.

Senator MALONE. That is correct. That means you have to be ready to put it in the field, not something that, just as long as you have peace you do not need any.

Colonel McDONALD. That is true.

Senator MALONE. But the history of all these wars and actions of nations seems to support the theory that you do a lot better at the conference table if you have enough at your back so they know if the conference blows up you are going to win the war. Go ahead.

Colonel McDONALD. Well, I have been pointing out the difference between requirements when you compute them for the current buying program of airplanes as contrasted to what you would do in an all-out war.

Senator MALONE. How can you buy it in an all-out war if you do not have it available?

Colonel McDONALD. That is true.

Senator MALONE. Let us forget about what we are going to do in peacetime.

I think if we have not got a set of men at the head of this thing thinking about an all-out war and getting ready to win it, and have the procurement already accounted for and have it on hand, I think we had better change the people we have at the head of it.

Colonel McDONALD. Senator, on this matter of mobilization requirements, we are at no difference with Mr. Harris' people. It is entirely agreed as to the quantities and amounts we need. I am sorry it is classified and cannot be given to you at this time.

Senator MALONE. You have told me that this morning, but the point I am getting at is you are responsible, I am talking now about the National Defense Administration, for furnishing the figures needed in this all-out mobilization to the Office of Defense Mobilization.

Colonel McDONALD. That is correct.

Senator MALONE. I did ask you this morning how far back this goes, where it comes from. Does it come from Wright Field first or does it come from other places or does it originate in Washington?

Colonel MCDONALD. The schedules originate at Wright Field. In other words, number of airplanes we are going to buy. Those schedules are transmitted to our aircraft and airframe builders.

Then based on those schedules and the materials usage they plan to put in the airplane, we develop the total requirements for material which we then transmit in the Department of Defense for consolidation with other Department requirements and subsequent transmittal to the Office of Defense Mobilization.

Senator MALONE. Have you reached the point yet that you have furnished this estimate of what you need and get it available so that in the event of an all-out war you can win it?

Colonel MCDONALD. Yes, sir; we have as Mr. Harris pointed out. Weeks ago this information was transmitted to Washington.

Senator MALONE. I do not think, speaking for one Member of the Senate, and who has been through two of these wars, that if any sensible person knows you can win it, you are not going to have a war and that is the way to do it.

Colonel MCDONALD. I agree.

Senator MALONE. That does not mean 2 or 3 of these long-range sonic speed bombers, it means two or three thousand of them.

Colonel MCDONALD. Yes.

Senator MALONE. It does not mean 3,000 or 5,000 fighters and interceptors, it means fifteen or twenty thousand of them; doesn't it?

Colonel MCDONALD. If you could get them, you would like them.

Senator MALONE. How are you going to get them if you do not ask for them, and figure out how much of each material—titanium, columbium, stainless steel, aluminum, and every other metal—if you do not know, how will you get it?

Colonel MCDONALD. We transmit the information on all materials as to what we feel we will need to win a war.

Senator MALONE. I think you are getting some place now.

Colonel MCDONALD. I think the only problem was I did not understand your question. When you asked about requirements, I thought you meant what we plan to buy now. On mobilization, I could not agree more with your statements and those of Mr. Harris.

Senator MALONE. Isn't peacetime the time to prepare for war?

Colonel MCDONALD. Yes, sir.

Senator MALONE. In other words, we have been threatened for 36 years—my war in 1917, when I quit the university to go in as a private. Here is what we were told, that if you allow Germany to dominate Europe, we are next.

Isn't that the history of it?

Colonel MCDONALD. Yes, sir.

Senator MALONE. Now Russia has taken the place of Germany and Japan threatening us.

Colonel MCDONALD. Yes.

Senator MALONE. At least in the propaganda and if it is propaganda, we had better find that out.

Well, now, military strategists have said that you can defend the Western Hemisphere.

And any area across a major ocean you defend, you have to do it from here and not with a foot army. They are dead when the

fight starts or on their way on to the salt mines. Also we developed what area you could defend in the first go-around—you can become self-sufficient in the Western Hemisphere for everything you need including titanium, uranium, and everything else. If you treated the taxpayers of this Nation half as well as you do the foreigners, the uranium will be running out of your ears in 2 years.

You do not have to go to the Belgian Congo and you cannot when the fight starts. So peacetime is the time to do it; isn't it?

Colonel McDONALD. I could not agree more.

Senator MALONE. If you have done it in peacetime you will not have a war, 90 percent certain you will not. That is the objective of this committee, to quit talking through our hats about us protecting Europe, protecting Africa, protecting the colonial system all over the world. Take Indochina, for example. The Indochinese weren't interested in fighting with France or with us because we were giving them the choice of continuing under colonial slavery with France or going Communist. They did not like Communists, but did not like colonial slavery.

So let us get out of our heads that we are going to put soldiers in all these nations.

You are the fellows with the wings that are going to have to do this fighting in the air and with submarines and guided missiles. I believe our American soldiers can whip anybody if you give them the material to fight with. But with a bayonet, man for man, with the Chinese, we haven't got enough boys to do that.

Colonel McDONALD. That is correct.

Senator MALONE. Now, Colonel, I am very glad to see you and we will look forward to seeing you in Washington when we have this other hearing. I appreciate your coming out and thanks a lot. Tell your people in Washington that we will get in touch with them when we get back there.

Colonel McDONALD. Thank you.

Senator MALONE. Mr. Harvey of the Harvey Machine Co.

Will you come forward, Mr. Harvey.

STATEMENT OF LEO M. HARVEY, HARVEY MACHINE CO.

Mr. HARVEY. Senator, I made a few remarks here and marked them down. I am not a public speaker, as you know.

Senator MALONE. That is better.

Mr. HARVEY. I appreciate the opportunity to appear before this committee. I am here particularly to listen and hear what is said. I have always found the hearing informative and elucidating.

It is my belief that this committee under the leadership of Senator Malone is performing a yeoman service for the defense of the United States of America, particularly in their aim to make the United States independent of foreign sources as far as strategic minerals and metals are concerned.

PROGRESS IN TITANIUM ALLOYS

We, at the Harvey Co., are continuing to perfect ways and means to fabricate titanium alloys.

Our personnel who are working on the titanium project have been greatly augmented and it is their task to develop ways and means

of what is best to be done to bring about full development of titanium and titanium alloys in all its forms.

It is my belief that one phase of titanium development has not been touched, that is, titanium fabrication, and I would therefore like to call the attention of this committee to the need for a titanium fabrication program, aiming at improved quality and quantity production of titanium and titanium alloy in the form of plate, sheet, bar, forgings, extrusions, and castings which would be of great help in making titanium available for airplane and engine application. We know that titanium and titanium alloys can help make stronger, lighter, and better planes and engines and can, also, greatly improve other military equipment.

It is for this reason that the titanium-sponge program was set up, research and development programs undertaken, and airframe and engine manufacturers encouraged to study titanium for use in their products.

These programs have been very effective.

Because of this sponge program, we will soon have a titanium-sponge production capacity of 35,000 tons or more per year. Some of the plants are already built, some under construction, and others in the planning stage.

The research and development programs on the technical phases of titanium have brought about a better understanding of titanium, helped to improve the early titanium alloys, devise new ones, determine the best heat treatments and handling methods, and to show where titanium might be most effectively used.

Encouragement of the manufacturers to study and test titanium for airframe and engine applications have shown many of the benefits to be obtained from such applications.

More engineering data is still needed and this requires more and assured sources of material to justify the work. Test installations in aircrafts and engines has led to increasing interest and to the prediction that 100,000 tons or more per year might be needed if we are called upon to build the best and most effective military planes and engines in large numbers.

The melting and fabrication of titanium has not kept pace with sponge production.

Because the demand for plate, sheet, rods, bars, and shapes has not been firm, it has not been possible to plan for melting and fabricating facilities or to work out all the technical problems involved in production of these mill shapes. The uncertain demand comes from the reluctance of designers to specify a new material in place of standard materials until engineering design data are complete, the cost of substitutions known, and the sources of supply for the new material established. All of these factors are interrelated and dependent on fabricating methods and hence titanium is caught in a vicious circle in which supply is choked by the lack of demand, and demand is held back by lack of engineering data, high costs, and lack of assured supply.

As we know, at the present time it has been necessary to use small melting equipment and to produce small lots of titanium forms on steel mills. This means that titanium has been fabricated into mill forms in small lots at high costs and with variable quality as a result of these methods.

Until fabricating methods are established and standardized by experience in production, and engineering data obtained on material produced by the best fabricating methods, variations in quality will continue and costs will remain high. Designers will therefore be slow to take advantage of the properties of titanium and to design it into military equipment.

Now then, instead of using steel equipment, separate and independent fabricating plants designed and arranged to suit the requirements of titanium and titanium alloys should be established.

These plants should be set up closer to the chief centers of airplane and engine manufacturers. In this way, titanium products of the necessary quality and in the required quantity can be assured.

The potential users of these products can then go ahead and design their equipment to take full advantage of the improvements which the properties of titanium will make possible and be confident that titanium will be available to them.

One more important phase we would like to submit before this committee is that scrap recovery should also be a part of the fabricating program. Scrap produced may amount to 20–35 percent of the ingot. For economy of operation and maximum production from a given amount of sponge, it is essential that the fabrication plant include the recovery of scrap. In making aluminum extrusions the salable metal will be approximately 70 percent of the ingot weight. The scrap consists of rejected ingots and extrusions, sawings, butt ends, and end discards. It is expected that the scrap situation in the titanium extrusion operations will be no better than the present aluminum extrusion process.

We are confident that correlation of fabrication processes with scrap recovery will aid in setting up fabricating methods that will produce the least amount of scrap and the least contamination of the scrap that is produced.

The titanium fabricating program suggested here is intended to assist the overall Government program of making titanium available for Army, Navy, and Air Force equipment and is aimed at what appears to be the present bottleneck, i. e., the fabrication of titanium and titanium alloys into standard grades of various shapes and forms, of satisfactory quality and with assurance of adequate production capacity. With availability and quality assured, designers of military equipment can then go ahead with their plans of making most effective use of this new and important metal—titanium.

I believe that is our findings and I thought I would bring it before you for whatever it is worth to you.

RECLAIMING TITANIUM SCRAP

Senator MALONE. I think that's a very important statement, Mr. Harvey. Now do you believe that it is possible ultimately to reclaim the scrap 100 percent?

Mr. HARVEY. Our investigation shows, or rather I would say, that the studies we made probably about 6 percent of the titanium sponge will be lost irretrievably.

Senator MALONE. That might be.

Mr. HARVEY. The balance can be reclaimed and reused.

Senator MALONE. It all can be reclaimed except what you might say would be lost in steel, too?

Mr. HARVEY. Yes, sir.

Senator MALONE. There is no reason why it cannot be reclaimed if enough investigation and research is put on it?

Mr. HARVEY. I am positive it can be done.

Senator MALONE. You say about 70 percent can be reclaimed now?

Mr. HARVEY. No; I said, right now 70 percent is used and 30 is lost in scrap.

Senator MALONE. That is in the beginning with the ingot. Of that 30 percent, how much can be reclaimed?

Mr. HARVEY. All except a very small amount.

Senator MALONE. How much at this time can be reclaimed?

Mr. HARVEY. At this time they reclaim very little because there is no way, no means of reclaiming, no effective means has yet been devised of reclaiming scrap.

Senator MALONE. Right now 30 percent is practically lost?

Mr. HARVEY. In making sheets, a sizable lot of titanium is lost, in scrap, in forgings a great deal more scrap is accumulated.

Senator MALONE. Now if you did reclaim that 30 percent, that is simply like that much additional production; is it not?

Mr. HARVEY. Additional production and what is very important, too, is that the cost will be reduced to a level that will be attractive for everybody to use it.

Senator MALONE. Because whenever you have a method of reclaiming the 30 percent that is lost, it will not be as expensive as going through the whole process of manufacture sponge and then the ingot.

Mr. HARVEY. That is right.

Senator MALONE. And there is no reason in your opinion why within a reasonable time with proper research that it will be used over and over and practically no loss except the natural loss of any metal when it is being machined?

Mr. HARVEY. That is right. We have a research team working all the time. We believe we are arriving at the solution of the problem. We furnished titanium extrusions but we believe they are too costly. We know it is too costly. My aim as operator of the company, is how can I get a good product at a lower cost? We are always looking for that. We set ourselves the task of finding a way to do it and we believe that our thinking and our approach to the problem is correct.

Senator MALONE. How far away is the solution of the scrap problem?

Mr. HARVEY. In the time element it is not scrap alone. It is also the alloying process which should be perfected.

All sponge, irrespective of the hardness we believe could be reclaimed and made usable by alloying methods, even if of high hardness.

Senator MALONE. What is the time element in research to bring this about?

Mr. HARVEY. In 9 months or a year.

Senator MALONE. A year is not very long because it will take that long to materially increase the production.

Mr. HARVEY. Of course the genius of men is in the lap of God. Nobody can set a time on God's will.

Senator MALONE. The genius of men is helped considerably when there are unlimited funds, when the metal is needed bad enough so there are unlimited funds for investigation; is that right?

Mr HARVEY. It helps a great deal.

Senator MALONE. It took a long time for aluminum because there was no war and it was not necessary to step it up.

Mr. HARVEY. It is not a question of war. It is a question of defense. We are looking for defense, not war.

Senator MALONE. That is true but in the first instance, we were simply looking, we did not get ready until the war was on us.

That is, the money was not available until then. Now we have learned a lesson I hope so that we are making the money available. Congress is making money available for anything that the National Defense Administration says is important to prepare for our proper defense.

Mr. HARVEY. That is right.

Senator MALONE. Therefore if you can make a proper case before the proper organization in Government on your project that you need to go into, you have not had much trouble in getting the proper setup to do it; have you?

Mr. HARVEY. Senator, what is meant by a proper representation is hard to tell. That is again a question I would say of salesmanship and the question is how good a salesman we are to present our case.

We do not win all the time.

Senator MALONE. Well, maybe we should not, but my point is this: That once you convince the National Defense Administration that a thing is necessary and probably will pay off, generally speaking the money is available; is it not?

Mr. HARVEY. I believe that is the case.

Senator MALONE. Then, if that is the case, we would like to know now where the logs are jammed on this thing.

I would like to ask you a question. If you want an airplane and you know how many miles an hour you want it to travel, wouldn't you submit it to Mr. Douglas or Mr. Gross and say, I want you to come up with this at the lowest cost possible? Wouldn't they do a better and quicker job and have a better chance at success than the National Defense Administration trying to set up a research organization to tell them how to make the plane?

Mr. HARVEY. You really want me to answer that question?

Senator MALONE. I do. I am asking you as a producer and let the chips fall wherever they may.

Mr. HARVEY. Any aircraft company has competent engineers to build a supersonic plane but to get the best results a certain kind of material is needed.

The aircraft companies do not make materials. Unless the material is available, they are at a stalemate. They are blocked. Furthermore and more important, for the present, we are caught in a vicious circle. The designer says, I will not design with titanium alloy unless I have a good alloy.

The fabricator of the titanium alloy says, I cannot go to fabricating the alloy because the demands are not there. I cannot put money into it because it takes a certain amount of facilities to do it and the demand is not there.

We are, therefore, caught in a vicious circle. When these conflicting tendencies appear we have a bottleneck.

Senator MALONE. It does not exactly answer my question but it raises another one. Why couldn't we go to an aircraft company and say that we want a plane that will do a certain thing, it will fly so fast and so far and carry such a load.

You design it and give us the design of the materials including the known materials, titanium, stainless steel, columbium, and everything else, that will do that job at the lowest cost.

Let us be responsible for getting those materials after we know what they are. Wouldn't they do a better job in designing such a plane than for the people that want the plane to go into the throes of design?

Mr. HARVEY. I do not believe I can answer your question honestly and correctly, and I would like to do it right.

You see, people are human beings and the mind and knowledge are developed by stages. It is not developed all of a sudden.

It is developed in stages, little by little. True enough, the stages are sometimes pushed ahead and accelerated by certain requirements, certain demands, but those stages are inevitable. I believe no aircraft company could say today, we are going to build a plane with materials best suited for the job, unless they have the metal and experience of what the metal will do. An engineer is a funny animal. He just doesn't believe what you tell him.

He says I am going to try it. And he says I am not going to try it once, I am going to try it 10 times.

Senator, we try things 100 times before we are satisfied.

Senator MALONE. That is what is the matter with the chairman of this committee. He does not believe any of it until he gets it down after being 30 years in the business.

Mr. HARVEY. That is the way to have a Senator who looks ahead.

Senator MALONE. But maybe I had better ask the question a little differently. There is no use of the engineer designing a plane using titanium unless you think they will get it for him?

Mr. HARVEY. That is right.

Senator MALONE. Wouldn't it be better if the National Defense Department lay down the specifications of what they want in titanium and how much of it and let the people in the business of making it, like the Titanium Corp., give them the specifications and put it right up to them? Isn't that the best way to do it?

Mr. HARVEY. I would like to answer that correctly. I believe that would be probably the best way to do it but, Senator, we are in a democracy.

Senator MALONE. Are we? It is indeed nice to know we are still in it.

Mr. HARVEY. Everybody watches the taxpayer's dollar.

Senator MALONE. Does he? I have watched $13 billion of it go across the Atlantic Ocean and I did not like it.

Mr. HARVEY. I understand the problem of the people——

Senator MALONE. That is this year.

Mr. HARVEY (continuing). Who have to O. K. a certain amount of money. Everybody looks down their throats.

Senator MALONE. Who?

Mr. HARVEY. The public.

Senator MALONE. Well, they are not looking very deep. Here is one instance of $13 billion that went to Europe this year and Asia.

I am a little disgusted with the whole thing myself, and I am ready to economize on everything.

Mr. HARVEY. I do not mean——

Senator MALONE. I am for putting this money where we are getting ready to defend ourselves in the only way the military strategists testify we can be defended and that is from North America. About 2½ years ago or 2 years ago the Department of Defense said we needed 35,000 tons of titanium.

A White House committee said 22,500 tons was needed. Everybody else in the United States that knew anything about it said 150,000 tons were needed. A year has passed. We are still talking about 35,000 tons. We get the information today confidentially, within 3 or 4 weeks that it has been revised, and I am anxious to know how much it has been changed.

Now, somebody is making this unavailable and have been for 2 years. After I thought everything was ironed out and we had determined how much was needed and how to go about it, I turned to some other job. Then I hear these rumors around Washington that we have too much titanium; it is running out of our ears.

Again I called on Dr. Flemming and Roy Hurley and General Metzger. I am not so sure but what you were there; at least, most of the boys were there that I thought knew anything about it. I find out what I already know and what any sensible person knew was that temporarily you had more titanium than you could use because you did not have enough to start using it.

I thought we were through worrying about titanium. We are going into 1955 almost as bad off as we were in 1953. I am tired of it. How are we going to get this business straightened out? I do not want to have to come back and embarrass the Titanium Corp. every time.

Mr. HARVEY. We are glad to have a Senator Malone that can do it.

Senator MALONE. I have not done it yet. I thought I had. You are a practical man. That appeals to me. They said it could not be extruded, and you went ahead and extruded it. Whether it is economical you can tell us.

What is holding this up? Is it in the production of the metal? Is it in the fabrication? Is it in the authorization or where is it?

Mr. HARVEY. Well, I would say it is mostly in the authorization to go ahead.

Senator MALONE. Authorization?

Mr. HARVEY. Yes.

Senator MALONE. Who is responsible for that?

Mr. HARVEY. Well, I do not believe there is anybody responsible for it. When I make a representation and it is not accepted I think I am a bum salesman. I had better be a better one to be accepted next time.

Senator MALONE. Who are you selling it to; somebody that does not know anything about it at all?

Mr. HARVEY. I would not say that. Selling to people that know all about it. We mostly handle it with the AMC.

Senator MALONE. What is AMC?

Mr. HARVEY. Air Materiel Command.

Senator MALONE. Who is that?

Mr. HARVEY. Wright Field.

Senator MALONE. We had Wright Field here a while ago.

Mr. HARVEY. That is right.

Senator MALONE. Didn't do too well at first. Now you sell it to them. Then they sell it to who?

Mr. HARVEY. That is something up the ladder that they are supposed to know. I am not even supposed to know it. I am only a citizen.

Senator MALONE. Now you remember me, don't you?

Mr. HARVEY. Very well.

Senator MALONE. I know you and I know better than that. I have seen you operate around Washington.

Mr. HARVEY. Now you embarrass me, Senator.

Senator MALONE. What would you do to get this material? You know just as well as I do that the minute this material is available the airplane companies can manufacture planes that can do much more than they can do now. Until it is available they cannot do it.

Mr. HARVEY. Well, I do not know. I believe that, as a private concern, we take more chances than the Government does. We take chances every day. I think the Government official must take a certain amount of chances, too, and go ahead and do it.

I think that is probably one of the reasons.

Senator MALONE. Getting past this authorization because we have had testimony that there is additional authorization coming up—at least it is started and we will find out what that is in Washington—has there been any research authorized for fabrication research?

Mr. HARVEY. Not with us.

Senator MALONE. Have there been any definite steps in that direction?

Mr. HARVEY. All I can say is for ourselves. I do not know about any other company.

I believe Colonel McDonald could answer that.

Senator MALONE. You are working on a research program?

Mr. HARVEY. We were.

Senator MALONE. What happened to it?

Mr. HARVEY. It is still in the Department being looked over.

Senator MALONE. Did you decide you were not a very good salesman?

Mr. HARVEY. That is right.

Senator MALONE. What were you going to do with it?

Mr. HARVEY. Keep on selling.

Senator MALONE. What were you going to do with it if you got the contract?

Mr. HARVEY. To do the work we think is necessary which we think will answer a lot of problems and will bring to light certain things.

Senator MALONE. Methods of——

Mr. HARVEY. Methods of alloying and fabrication which we propose.

Senator MALONE. You were going to prepare a record that would be helpful to any company coming into the business?

Mr. HARVEY. That is right. You see, in reality, when we do it through Wright Field it is of benefit to all concerned because we

give a report of everything we do. If it would be privately done, the results would not be known to the industry. In this particular instance, when Wright Field is the sponsor, all inventions and patents development belong to the Government, and anybody can use it. The results would be known to everybody in the industry. The methods of approach would be known to everybody. It is then an open book for the benefit of the entire industry.

Senator MALONE. If you or anybody else had a Government contract to do it, the results could be utilized in any contract with anybody.

Mr. HARVEY. That is right.

Senator MALONE. Let me ask you a general question. You are interesting yourself in this metal; you are a businessman; you would not be doing this unless you thought there was a future in it and an ultimate profit in manufacturing things from it or manufacturing the metal itself.

What do you feel about the future of this metal in civilian use and in military use? Do you feel it justifies all of this work that this subcommittee is doing and that other committees may be trying to do in the Government departments? What do you think about it?

FUTURE OF TITANIUM

Mr. HARVEY. I have full faith and it is not a question of faith, it is a question of certain knowledge that we possess, we believe in the future of the metal. And we are devoting our own time and energies, hiring people, and they are expensive. We are committed to the titanium program in the firm belief that titanium metal will be all right.

Senator MALONE. People in on the ground floor will make money eventually.

Mr. HARVEY. Yes, sir.

Senator MALONE. I thought so. Now I do not think Donald Douglas would be in the plane business if he did not think there was a future in the plane business.

Mr. HARVEY. And of course, Senator, paramount today is also the requirement of this country. Let us not forget that we live and make a living in this country and we want it to be defensively strong and the only way it can be strong is to have the best aircraft in the world. Conversely we must have the proper kind of metal and, particularly, titanium, to enable this country to produce the best aircraft.

Senator MALONE. Do you believe the only way to have the best air corps in the world is to have enough of this metal along with the other necessary metals to do the job?

Mr. HARVEY. That is right.

Senator MALONE. Is there any other metal you know of, a light steel combination or any other metal that approaches this metal in effectiveness at the moment or any in sight?

Mr. HARVEY. Not at this time. I believe it will develop because progress never stops. We keep going. We find out things that are just amazing to us. It would be folly on my part to say we would not develop a better metal or method.

Senator MALONE. Over the long-term future, but at the moment you do not know of any better one or one talked of?

Mr. HARVEY. That is right. I believe the country needs it for its own protection.

Senator MALONE. Now if what you believe is a fact, I believe, from the information we have, that this is a metal not approached at the moment by any other metal in light weight-strength ratio, corrosion resistance, and heat resistance. I think it is a metal that stands by itself. You believe that?

Mr. HARVEY. That is right.

Senator MALONE. Until we get a better metal or one that approaches it, you believe, as I do, that it is necessary to make progress?

Mr. HARVEY. That is right.

Senator MALONE. Now, this committee found some very interesting things as we went back into the history of availability of critical materials.

People working for the Government were deliberately retarding the development of these materials in this country. There have been outstanding people caught at that business.

Therefore, for 20 years we thought we did not have anything. I did not think so. You can defend the Western Hemisphere. You can produce everything in it you need in this particular metal, the fourth or fifth or sixth most plentiful raw material in the world in the earth's surface; you do not have to go outside the United States.

But what is holding this thing up?

Why do we meet this talk that we do not need titanium? Who is responsible for this thing? All added up, it means we make no progress. Or very little. We make it so slowly. We are now dependent on 5 or 6 foreign nations you could not reach 2 hours after war is declared for material you cannot fight without.

Now we are developing the new metal better than any of it, and you cannot get the raw material for it 2 hours after war starts. So we have people saying we will have to have more research, it is going to take 2 or 3 years or you are going to have to set up a new committee to do this research to check it. Isn't what we need a little action some place? That question was directed at you, Mr. Harvey.

Mr. HARVEY. Senator, I am going ahead and doing all I can. I am not stopping.

Senator MALONE. Even if they turned you down?

Mr. HARVEY. I will go right ahead. I will submit another proposal and keep on doing research. We are not stopping.

Senator MALONE. You are not going as fast as you could, either, if you had some opportunity to do it, are you?

Mr. HARVEY. That is right. We can do better.

Senator MALONE. Do you have any other suggestions that you think would be helpful to the committee?

Mr. HARVEY. None that I think of right now, Senator. I will do all I can to help the titanium program and help you, Senator. You know that. You know my ideas about using domestic raw materials. I have already expressed that. You know I am for it. I do not believe in depending upon foreign countries for vital supplies. We should develop our own right here. I have expressed it once before. As a matter of fact, we are going to the extent of developing bauxite right here in the United States and spending lots of money in developing work.

Senator MALONE. Now along the lines that you mentioned, 1 of our 12 recommendations was a recommendation that we raise the depletion allowance on taxes and this committee's work was completed in time luckily for the meeting of the Senate Finance Committee on taxes and Senator George and Senator Byrd and others took it up and raised the depletion allowance from 15 to 33 percent on 21 metals including ilmenite and rutile. In your opinion, would that encourage production?

Mr. HARVEY. Yes, it will.

Senator MALONE. I thought it would, and we made that definite recommendation and it was taken by the Congress almost immediately.

Mr. Harvey, I appreciate your appearing here and just keep up the good work and if we have another hearing in Washington we will notify you.

Mr. HARVEY. Thank you.

Senator MALONE. We have E. J. LeFevre of Convair, San Diego. Mr. LeFevre, will you come forward?

Mr. LeFevre, you have one of your organization with you. Will you identify yourself and your assistants.

STATEMENT OF E. J. LeFEVRE, ASSISTANT TO THE VICE PRESIDENT FOR LONG RANGE PLANNING AT CONVAIR; ASSISTED BY LOWELL W. GORDY, MATERIAL ANALYST, CONVAIR'S SAN DIEGO DIVISION

Mr. LEFEVRE. I am Edward J. LeFevre, assistant to the vice president for long-range planning at Convair, a division of the General Dynamics Corp. This is Mr. Lowell W. Gordy, who is the material analyst in our San Diego division long-range planning section.

Senator MALONE. Mr. LeFevre, we have asked you to come here because we know you are intensely interested in material development that goes into the manufacture of planes.

You may proceed in your own way. If you have a written statement, you may read it and give us any information you think would be helpful to the committee.

Mr. LEFEVRE. Thank you, Senator. I have a prepared statement.

First I would like to say that Convair's interest in utilizing titanium in the development and production of modern aircraft and our position relevant to the importance of the titanium program to the aircraft industry has not altered since the last meeting of your subcommittee in October 1953, when Mr. T. G. Lanphier, vice president, testified on behalf of Convair.

IMPROVEMENT IN QUALITY OF TITANIUM

It may be of interest at this time, however, to point out that since that meeting, the quality and quantity of available commercially pure and alloy titanium has improved to a certain extent. While hydrogen embrittlement and shear cracking due in part to the unusual absorption qualities of titanium at elevated temperatures continue to pose serious problems, the number of shop rejects of titanium has declined and the amount of waste material has been reduced during this period.

Senator MALONE. Scrap?

Mr. LEFEVRE. Yes, and shop rejects. We are now recording approximately 10 percent rejects at our receiving station and about 15 percent in the shop. We also scrap about 15 percent in our fabrication shops.

We feel that progress in sponge development techniques is primarily responsible for this improvement in the quality of titanium. Du Pont and Titanium Metals Corp., have effected good results in their efforts to control high-purity sponge and, consequently, suppliers such as Rem-Cru, Mallory-Sharon, Titanium Metals Corp., and Republic Steel, with improved techniques, have exhibited some improvement in uniformity of quality in their titanium products.

In addition to this improvement in sponge development, it should be noted that cooperation by mutual exchange of information between prime contractors as well as cooperative research and development programs between suppliers and the manufacturers has resulted in some new fabricating techniques with respect to titanium metals. This is very significant. We are working together as closely as we can in this program.

At our San Diego plant, personnel from our factory, material section, engineering and purchasing departments, meet weekly to review and solve, if possible, those problems concerning the handling of titanium on our production line.

INCONSISTENCY OF TITANIUM ALLOYS

While some progress has been made in the quality of titanium, our manufacturing shops are continuously plagued by the inconsistency of the titanium alloy metals. At present, surface condition of the material must be acid etched to eliminate scale and small scratches when more difficult parts are to be formed. We expend many man-hours a month to remove shear cracks and laminar cracks during fabrication. Additional handling such as this requires approximately 2 to 3 times as long to process an alloy titanium part through the shop as compared to a similar part of stainless steel. This is a costly process and one which should not be overlooked when reviewing the titanium picture.

Our shop people report that present manufacturing equipment is not adequate to successfully form titanium at high production rates. For instance, our hot-brake dies are slow to heat and awkward to change, stretch-press controls are not sensitive enough to handle material that has such a small span between yield and ultimate, hydropress rubber will not withstand the high temperatures (800° to 1,000° F.) required in forming operations, and die materials and lubricants leave much to be desired when working with titanium metal.

With respect to the current availability of titanium mill products, our buyers are reporting a lead time of from 12 to 16 weeks for sheet and bar titanium which, in our estimation, is within reason and quite adequate for our present production programs. We believe this improvement in availability is due in part to the following factors:

1. Increased sponge production.
2. Greater furnace capacity at the mills.
3. Improved mill quality control.

4. APRA cooperation relative to the scheduling of all mill orders and the controlling of titanium deliveries to the consumer.

This is very important.

5. When the supply was short all manufacturers ordered ahead and have been working off this accumulated inventory. That is what we are doing now.

We have slipped in some of our schedules. In one instance which I can mention without violating security, we slipped in production and therefore our titanium requirements diminished for that period. I will give you figures which are quotable at this time.

Senator MALONE. Was the slip due to the availability of titanium?

Mr. LEFEVRE. No; it was not. The slip was due to an unanticipated delay in the development stage of the program. I would not like to get into that at this time for security reasons.

Senator MALONE. That one point was all I was interested in, anyway.

Mr. LEFEVRE. Titanium required for existing and proposed contracts for the years 1954 through 1958 follows:

Titanium requirements

[In pounds]

	1954	1955	1956	1957	1958
Bomber	44,400	17,010	21,340	23,300	30,800
Fighter	53,675	57,081 [1] 70,280	[1] 517,444	[1] 1,286,946	[1] 1,580,400
Total	98,075	144,371	[1] 538,784	[1] 1,310,246	[1] 1,610,400

[1] Estimated.

The reduction in requirements since those originally forecast is due to:

(1) A decrease in the attrition rate of titanium.

(2) A stretch-out in planned production schedules.

Senator MALONE. This is a fast step.

Mr. LEFEVRE. Yes, sir. This is, of course, based on estimated production schedules——

Senator MALONE. How many tons in 1957?

Mr. LEFEVRE. Approximately 650 tons. This can change overnight should we go into all-out war.

Senator MALONE. If it were available, you could use——

Mr. LEFEVRE. If it were available and the quality satisfactory and developed to our specifications we could use more.

To continue:

(3) We have increased shop experience.

(4) Some improvement in fabrication techniques and inspection methods.

(5) Engineering design reticence due to lack of uniformity and need for higher allowables.

Senator MALONE. What is the general percentage of weight in the plane? We had testimony from several plane manufacturers that range from 25 to 40 percent if you had the titanium and developed the necessary alloys.

Mr. LEFEVRE. This will be covered later in the testimony.

Senator MALONE. Go ahead.

Mr. LEFEVRE. Disposal of scrap remains a serious problem with titanium and we are still having trouble getting rid of alloy scrap. We had a recent experience at our Fort Worth plant where we sold 20,000 pounds of segregated titanium scrap at 58 cents a pound. This cost us approximately $20 a pound.

Senator MALONE. You are saving the scrap, however, just like you have been from the start.

Mr. LEFEVRE. Yes; we are stockpiling it. We currently have 15,000 pounds of scrap on hand at our San Diego facility.

Senator MALONE. Awaiting the time it can be utilized?

Mr. LEFEVRE. That is right.

We sold some to junk dealers who were speculating that they might have a real find with scrap titanium. We understand they still have the scrap on hand and cannot get rid of it. Research and development is the next area I want to discuss.

RESEARCH AND DEVELOPMENT OF TITANIUM

Convair recognizes the merits of titanium and, in addition to designing this new experimental metal into some of our aircraft, has undertaken various research programs, both company sponsored and Government financed, to examine the potential of this metal in future development of supersonic aircraft. At the moment, intensive titanium research is under way in the following fields:

1. Heat treatable alloys in bar forms at strength levels of 200,000 pounds per square inch.
2. Heat treatable alloy sheet at strength levels upward from 150,000 pounds per square inch.
3. Extrusions and forgings.
4. Bolts and other hardware such as tube fittings.
5. Improved shop forming methods.
6. Surface coating of titanium to counter galvanic action from contact with other materials.
7. Fatigue studies.
8. Fusion, seam and spot welding studies.

As a result of this research, Convair's engineering department recently presented a progress report to the National Aircraft Standards Committee of the AIA regarding the development of titanium fasteners, tube fittings, and other hardware for aircraft construction.

In this report, Mr. S. R. Carpenter, staff engineer for Titanium Research, set forth the following example with respect to the weight saving that can be realized by utilizing titanium high strength shear bolts, couplings, and tube fittings in the construction of supersonic aircraft.

> At Convair, San Diego, more than 18-million shear-type steel screws and bolts in sizes 3/16-inch and 1/4-inch diameter were issued in 1953 for factory installation. Weight of these steel fasteners is estimated to be 124,000 pounds, whereas, in titanium, their weight could be approximately 70,000 pounds. A million pounds of titanium screws and bolts are quickly reached if these requirements, plus 1 or 2 other fastener sizes, were multiplied by the needs of a few aircraft companies: Add other titanium hardware and the estimates are increased many fold.

This represents a potential market for titanium which heretofore has not been included in the immediate future for titanium metals.

The estimated requirements for titanium at Convair were based on present information relative to the quality and workability of current commercially pure and alloy titanium for those programs being developed and produced for the military.

We are not using titanium today in commercial aircraft.

Further use of titanium in aircraft construction is governed in part by the following:

1. The development of alloy titanium having uniform quality and improved strength weight ratio.
2. A reduction in price.
3. Improvement in machine tools and fabricating techniques for handling titanium metals.
4. An increase in performance requirements leading to a need for more weight reduction in supersonic aircraft.

At present, it is estimated that approximately 4 percent of the airframe weight of one of Convair's aircraft is titanium. In the future, it is conceivable to estimate that approximately 40 percent of the airframe weight will be of titanium metal.

This past summer, Convair's engineering preliminary design group completed an engineering study of an airplane required to operate at Mach 2.5 to Mach 3.0 at 40,000 feet.

At this speed, temperatures were extremely high and it was realized dural would be extremely inefficient from a structural standpoint. Consequently, it was concluded from this study that the most suitable metal for this type of airplane would be titanium alloy. Most of the estimated 10,000 pounds structural weight of such an airplane would be titanium metal.

That could amount to 90 percent of the structural weight.

Senator MALONE. Ninety percent?

Mr. LEFEVRE. Of the structural weight of the aircraft.

Senator MALONE. Eventually.

Mr. LEFEVRE. It could possibly be.

Senator MALONE. And be profitably used.

Mr. LEFEVRE. Yes, sir; provided the quality is of the standard we want.

Senator MALONE. Even at the present price it would increase the commercial load in a commercial plane and increase the range and performance of the military aircraft so that it would pay to use it whenever you reach the point where you can use it.

Mr. LEFEVRE. I am speaking strictly of military aircraft where, when you have to meet an enemy, sometimes, money is not an obstacle.

Senator MALONE. That was a point we made early in this subcommittee that we did not think Congress would stand back on money if that stood between them and the best airplane. Someone said, it may have been the chairman who first said it, a second best air corps is like a second best poker hand.

Mr. LEFEVRE. That is right.

Senator MALONE. You just do not have it very long. I think you are exactly right. If you got into the commercial field, it was testified that they could pay a considerably greater price than $15 a pound and make it back during the life of the craft through the increased payload, but that is another question that you have not taken up here.

Mr. LEFEVRE. I have not gone into the application of titanium in commercial aircraft.

Senator MALONE. Sometime if you did go to such an angle the subcommittee would be interested in receiving the results of your study because we still come back to the proposition that the only thing that makes a metal critical is because you do not have enough of it. If you had a large domestic civilian industry in titanium that utilized as much or more than you need in military, then it would be no longer critical. It would be like stainless steel or aluminum. We are not worried about the quantity because you can get it tomorrow. We are intensely interested in what your study might show as to whether it would be advantageous in the use of commercial aircraft at the present price.

Mr. GOODY. That study happens to be under way now.

Mr. LEFEVRE. We will try to get the results when available.

Senator MALONE. How soon would it be available?

Mr. LEFEVRE. We'll have to check that point.

Senator MALONE. How long?

Mr. LEFEVRE. I am afraid to say.

Senator MALONE. Three months, one month.

Mr. LEFEVRE. At least 3 months.

Senator MALONE. I wonder whether as a part of this testimony of yours, if it comes in in time—and I have every reason to believe it would—would you make that part of your testimony?

Mr. LEFEVRE. Yes, sir; we will. We have just entered into the study from a commercial viewpoint and I did not include it here because of its status.

Senator MALONE. You see our reason for wanting it?

Mr. LEFEVRE. Yes.

Senator MALONE. If we could get this out of our hair as a critical material the minute enough of it is being used in civilian industry to equal about what the military needs in time of war, that is the objective of course. Go ahead.

Mr. LEFEVRE. That concludes my testimony, sir.

Senator MALONE. Your testimoney will be furnished you and you can rearrange it for completeness and accuracy.

I think we have cleared this up, due to the fact that Mr. Harris testified there has been a new estimate come in from the Administrator of National Defense, which is classified information, but will be given the committee in Washington in executive session.

I take it from your testimony you are ready to use it up to any feasible percentage from 25 to 90 percent as you progress with it, with its fitness and availablity, if you knew it were available you would design it up to whatever is feasible at that time?

Mr. LEFEVRE. That is right.

I would like to qualify the 90 percent.

Senator MALONE. I understand that.

Mr. LEFEVRE. That is structural weight and when we get up to speeds we were talking about, we are going to need metals such as titanium to withstand the temperature.

Senator MALONE. What speeds?

Mr. LEFEVRE. Mach. 2.5 to 3.

Senator MALONE. What is that in miles per hour?

Mr. LEFEVRE. Three times the speed of sound which varies at different altitudes and temperatures.

Senator MALONE. 1,800 to 2,000 miles an hour. You would be talking about guided missiles at the moment?

Mr. LEFEVRE. Could be. Yes, sir.

Senator MALONE. But my question then remains the same. If you knew the metal were available, if the Government took the responsibility of going right ahead and making it available in specifications that would fit your work, there would be no difficulty in your design and you would put it in just as fast as it were feasible; is that right?

Mr. LEFEVRE. If we had the specifications of the top alloy titanium we want, we would use it.

Senator MALONE. You could not go ahead and demand it until you knew you were going to get it?

Mr. LEFEVRE. Yes, sir. We are going back again around the circle.

Senator MALONE. I wanted you to explain it.

Mr. LEFEVRE. Well, when an aircraft manufacturer is approached by the military to develop a certain type aircraft, desired specifications and performance of the airplane are established by the customer and the manufacturer is expected to meet these requirements if he hopes to obtain a production contract. To meet these requirements, aircraft designers may have to consider the application of certain titanium alloys in those areas where high temperatures preclude the use of dural and the weight of steel prohibits the utilization of this heat-resistant material. If titanium products capable of satisfying the desired specifications established by the designers are available from the suppliers, the material will be designed into the aircraft and the military so informed of the manufacturer's need for this type metal.

Senator MALONE. But it is up to some other agency, which could only be the Government in the case of the pioneering part of it, to make this metal available to you.

Mr. LEFEVRE. When we need the metal, we order it from the supplier.

Senator MALONE. Whoever it may be.

Mr. LEFEVRE. That is right.

Senator MALONE. But when you are looking for new suppliers, these contracts are mostly made with the Government.

Mr. LEFEVRE. Yes, sir.

Senator MALONE. In the beginning, at least?

Mr. LEFEVRE. Yes.

Senator MALONE. Then if it is available, you would use it, but you could not design the plane and put it on the production line unless you knew absolutely it would be available?

Mr. LEFEVRE. We could not design the plane and presume to build it without the material.

Senator MALONE. I appreciate your appearance here. I know it is a hardship, and I think you have listened to enough of this testimony. If you have any suggestions, we will be glad to have them.

Mr. LEFEVRE. I do not have any suggestions. I think the committee is doing an excellent job in trying to ferret out the bottleneck and keep titanium moving in industry and in the field. I think it is a matter, in my own personal opinion, of everyone getting together and cooperating. It is as simple as that. The supplier, the manufacturer, the military, together we can do a great deal to push titanium development with the aid of the administration which you represent.

Senator MALONE. I think you can and the Senate detected a need for some intervening agency and they conceived it to be a Senate committee. Therefore they passed this second resolution, 271, extending the work.

We know from long experience with Government agencies that a Government man can only run his neck out so far or there will be a casualty. But if he has a Senate committee and has reasonable expectancy that the Senate committee report will be accepted by a number of Senators on the floor and they are at least encouraging him on the work, it may encourage this very cooperation you are talking about.

I thing that is the thought behind this committee.

Mr. LEFEVRE. I think so.

Senator MALONE. Thank you very much.

Mr. LEFEVRE. Thank you, sir.

Senator MALONE. Mr. Luther P. Spalding is here from the North American Aviation. That is the company of which Mr. Lee Atwood is president.

Will you identify yourself for the purpose of the record and give us any information you think would be helpful? You have been listening to the testimony and you know the objectives of the committee.

STATEMENT OF LUTHER P. SPALDING, CHIEF RESEARCH ENGINEER, NORTH AMERICAN AVIATION, INC., LOS ANGELES, CALIF.

Mr. SPALDING. My name is Luther P. Spalding, chief research engineer, North American Aviation, Inc.

Senator, I do not have much to add to the statement which Mr. Atwood made before your committee in Los Angeles about a year ago. The general situation in our company regarding titanium utilization has not changed materially in that period. I can give you a few figures bringing things up to date over what we presented at that time.

Senator MALONE. We will be glad to have it.

Mr. SPALDING. We indicated a year ago that our estimated consumption of titanium for 1954 would be 830,000 pounds and for 1955, 790,000 pounds. At this date in 1954 it appears that our actual utilization will be in the neighborhood of 650,000 pounds. That is somewhat less than the 830,000 we anticipated a year ago. The primary reason for this reduction was the strike at our company in the late months of 1953, which resulted in some schedule changes in the first quarter of this year.

Now going to our 1955 estimates, which as I indicated, we previously calculated at 790,000 pounds, we now believe will be 1,100,000 pounds. This figure is based essentially on firm contracts.

For 1956 our estimate is in the neighborhood of 1 million pounds, this being based on some firm contracts which extend into that period plus anticipated figures.

Senator MALONE. It would not be any more materially increased from 1955?

Mr. SPALDING. We do not know that, Senator. This is our prediction as of today.

Senator MALONE. But you estimate it to be about the same?

Mr. SPALDING. Yes, although, as my other figures just showed, in the past year our 1955 estimate has gone up by roughly 25 percent. In other words, we got more new business than we had anticipated a year ago.

Senator MALONE. You are depending on the business that you may receive?

Mr. SPALDING. That is right. It is our best guess at this date.

Senator MALONE. Go right ahead.

Mr. SPALDING. One other group of figures which we discussed at the meeting a year ago had to do with the amounts of rejects and scrap and other losses. Our figures rather closely paralleled those given just now by the representatives from Convair. On the average, over the past several months we find that our rejections of incoming material (that is, not meeting specifications) is about 15 percent. The loss due to trimming of formed parts is around 35 percent.

Senator MALONE. Is that the scrap?

Mr. SPALDING. Yes, and the loss due to defective fabrication, parts which we break in trying to make them or otherwise, will run about 8 percent.

Senator MALONE. Totals pretty high?

Mr. SPALDING. Yes.

Senator MALONE. About 58 percent; only 42 percent usable.

Mr. SPALDING. That is correct; yes, sir.

Senator MALONE. What happens to this scrap now? Any percentage of that reclaimed at the present time?

Mr. SPALDING. We have sold a rather limited amount of that back to some of the producers. They will occasionally take segregated scrap at a figure of about $1 a pound. We have not been successful in disposing of much of it. I believe we have on hand right now something like 150,000 pounds.

Senator MALONE. All the scrap is being saved in all instances hoping that there will be a method devised to reclaim it.

Mr. SPALDING. Yes, or sold back to the producers.

Senator MALONE. What do the producers do with it? Do they reclaim a portion of it or just save it?

Mr. SPALDING. I cannot really speak for them. I understand they are utilizing some scrap, but I do not know the details of that.

Senator MALONE. Go ahead, then.

Mr. SPALDING. A year ago we also stated that we were having very considerable difficulties in procuring the amount of titanium we needed for our current production schedules. Since that time the situation has eased very materially and at the present date our purchasing people advise us that they are having no particular difficulty in buying the material we need—that is, the quantities of material we need—on a 3- to 4-month delivery basis.

Senator MALONE. Do you have any knowledge of any foreign country that is shipping any titanium into this country or contemplating doing so?

Mr. SPALDING. I have no knowledge of it, sir. I believe that is about all I can add as I say to the testimony given a year ago which I believe covered our situation except for these up-to-date figures.

Senator MALONE. The committee has not been too well satisfied with the methods of estimating needs for national defense and for carrying it through.

You only order the titanium that you know you can use and you have reasonable expectancy will be available. Your design keeps abreast of the availability of this material approximately?

Mr. SPALDING. Yes, sir. In fact, in the past it has been a little bit ahead of it.

Senator MALONE. Now it is catching up with you but you, in your new designs, you merely attempt to use up what you thought you could get of the proper grade.

Mr. SPALDING. Well, the matter of quantity has not been, is not now, of real concern to us; that is, as of today.

Senator MALONE. It has not been? It is available.

Mr. SPALDING. That is right. It was the problem a year ago on an immediate basis. It is not now on an immediate basis. We do not have the problem as far as quantity is concerned. However, we are not yet satisfied with the quality of titanium in all respects as many of the others have testified.

The strength properties and other characteristics are not as good as we would like to see them. However, in our new designs, we go out on a limb a little bit and we assume that for a design that we will have in work 2 or 3 years from now that the properties of titanium will be somewhat better than they are now, and we gamble to the extent of designing on that basis. We did that 3 or 4 years ago.

Senator MALONE. You try to keep abreast of the availability of certain materials that are included in the makeup of your plane?

Mr. SPALDING. Qualitywise.

Senator MALONE. That is a good expression. Now if you knew there was more of it going to be available, would you keep increasing the amount you put in your plane?

Mr. SPALDING. More quality?

Senator MALONE. More of the right quality that you knew would be available or had reasonable assurance.

Mr. SPALDING. We do not need any more right now. We have advance designs which would utilize a higher percentage of titanium than our present designs do and which would require titanium of better properties than we are getting at present but we have not gotten orders for those airplanes as yet.

Senator MALONE. When you do the demand will be there.

Mr. SPALDING. Yes.

FUTURE USE OF TITANIUM

Senator MALONE. Tell us what percentage of titanium you are using in your manufacture, generally speaking, and the percentage that you would use if it were available in the foreseeable future of the proper alloys and so on.

Mr. SPALDING. Yes, sir. At the present time we are using from 1 to 5 percent of the airframe weight in a number of our current production airplanes. As to the future, Mr. Atwood covered this a year ago and I can do no better than essentially repeat him. We be-

lieve that the percentage can go to 60 or 70 percent of the airframe weight at some future date, maybe 10 to 15 years.

Senator MALONE. Whenever the proper alloys and the amount is available, you think that the foreseeable future holds that possibility of going up to 70 percent?

Mr. SPALDING. Yes. However, there are additional provisos. One of the major ones is the engines, which would be required to operate at the very high speeds which would require the 60 or 70 percent of titanium in the structure. The present engines would not do that.

Senator MALONE. We have testimony from the representatives of the engine companies like the Curtiss-Wright Co. that they are prepared to manufacture such engines. That is to say as titanium of proper quality is available they can add part by part until finally they have what they need but do it in a way so that they just do not try to use titanium that is not available, not try to make it all at once but make the kind of engine I would assume you are looking forward to using in your type of plane when the proper alloys and proper amount of titanium alloys are available.

Mr. SPALDING. I am not an engine designer, sir, but as I understand it, there are perhaps two parts to this engine development. The use of titanium in either a present engine or some future engine offers the immediate advantage of substantial weight saving.

As to the design of an engine to go at 1 or 1½ times the speed of sound versus 3 times the speed of sound, that is a matter that involves more than the use of titanium. Not being an engine designer I cannot go much further than that but that is my understanding.

Senator MALONE. That is true, we are only considering titanium at the present time. It would have to be a rounded-out job.

Mr. SPALDING. Yes.

Senator MALONE. It was pointed out by Mr. Hurley and others in testimony that when you save a pound in the airframe and you know that when you are designing the engine it makes a difference in that design, makes a difference in your wing spread and other parts of the plane and the engine which must be a coordinated effort.

Do you have any further statement?

Mr. SPALDING. No, sir.

Senator MALONE. Your testimony will be returned to you and any additions you care to make for completeness or accuracy you are perfectly at liberty to make. As a matter of fact, it is helpful to the committee that it is accurate when we finally use it.

Thank you very much.

Mr. SPALDING. Thank you, sir.

Senator MALONE. We have Mr. F. S. Wartman, of the Bureau of Mines, Boulder City.

Mr. Wartman, will you identify yourself for the purpose of the record? We are calling you for the principal reason that there has been a change in the setup of your bureau here, that is, the objectives of your work.

Would you describe after identifying yourself for the purposes of the record, will you describe what the change is and what the objectives now are going to be of this Bureau?

STATEMENT OF F. S. WARTMAN, BUREAU OF MINES, BOULDER CITY, NEV.

Mr. WARTMAN. All right.

My name is Frank S. Wartman. I am head of the Electrometallurgical Branch of the Metallurgical Division, Region 3, Bureau of Mines.

I might outline first a little bit of the way that the titanium program in the Bureau is organized to get the background of that work at Boulder City.

The planning and coordinating and economic phases of it are mostly carried on by Mr. Cervenyak who is Chief of the Light Metals Branch in Washington.

The experimental extractive metallurgy is carried on almost entirely at Boulder City. The work on fabrication welding, and that sort of thing is done at College Park. Both the Albany station and the station at Rolla have done some work on beneficiation of domestic ores.

Now as to the work at Boulder City, our primary purpose is to attempt to develop improvements in processes for making titanium sponge or other forms of primary titanium. That has been partially sponsored by the Ordnance Corps of the Army. We found that the development, one of our objectives which the Ordnance Corps was most interested in, was the development of a continuous process. We found that was somewhat more difficult to attain than we anticipated and also it developed that it might not be too great an advantage economically and because of that delay certain of our facilities were not in use.

So the General Services Administration made a contract with us or we made a contract with them to produce up to, I think, 500,000 pounds of sponge in those unused facilities. That contract has been, was completed as far as production went, I believe the 9th of August. In order to utilize the crew and facilities, we were requested by General Services Administration to put in some proposals what you might call large-scale development work dealing principally with the Kroll process and chlorination of domestic ores.

The original proposal which was prepared by Mr. Lloyd and Mr. Cervenyak was rejected and we prepared a slightly modified proposal which was also rejected. Then we prepared a third proposal which dealt only with smelting and chlorination of domestic ilmenite especially ilmenite from Idaho, and that third properly was rejected.

Well, by that time we were at the point where we had to make some decision as to disposal of the crew because we were required to give them 30-day termination notices.

Since we had no further use for that facility or for the crew, we were forced to issue termination notices for all those men who had been operating the production work and they have now all been terminated. The facility has been cleaned up and is in standby condition. That termination of the production work did not affect the course of the regular investigative program on titanium which is continuing within the limits of this year's appropriation.

That work deals as I said primarily with an attempt to improve the extractive technology of titanium. At present we are working trying to develop a method for using sodium rather than magnesium

as a reducing agent and we are working on the development of the electrolytic method for purifying scrap or spoiled sponge and we are continuing on a very small scale with the beneficiation of domestic ilmenite.

That work has been going on a number of years.

I think that summarizes the present status of our operation.

Senator MALONE. Now how many of these men, employees were terminated under the conditions you outlined?

Mr. WARTMAN. Well, I do not know the exact number.

Senator MALONE. Just approximately.

Mr. WARTMAN. In the titanium development section alone—in the whole plant it amounted to somewhat over 100 because, not only the development section had to be terminated, but all the supporting services likewise—the machine shop, laboratory, and the clerical workers in the office—everything else had to go that were connected with that work. It amounted to about 50-percent reduction in the course of the station.

Senator MALONE. Now in this work of determining—and I do understand that you either now have a project in hand or will have one to determine the best methd or feasibility of changeover from the raw material, rutile to ilmenite—what amount of personnel will be necessary for that work? Any additional?

Mr. WARTMAN. Well, we will have to go out and get a new crew somewhere; yes, sir, because we intend to go on with the work we are now doing so that this additional work requires going out and recruiting new workers.

Senator MALONE. How many new workers?

Mr. WARTMAN. That depends entirely on the money. We do not have any such program at the present time.

I only have recently heard that there were more discussions again on it and the proposal was approximately $600,000 I believe for a 2-year period.

Now that is to be divided between the Albany station, who will do certain parts of the work, and the Boulder station will do the actual chlorination work and testing out the quality of the titanium chloride.

I would say that probably it will not mean more than 20 employees at most.

Senator MALONE. Additional?

Mr. WARTMAN. That is right.

Senator MALONE. A balance of about 80——

Mr. WARTMAN. Yes.

Senator MALONE. How long a job and what is the magnitude of the job of determining the best method and procedure in utilizing ilmenite instead of rutile?

USE OF ILMENITE

Mr. WARTMAN. Well, I think we can make a fairly good, a fairly adequate survey of the possible techniques and indicate which ones are most feasible in the 2 years that is proposed to be allotted.

Senator MALONE. You think it would take 2 years before the Titanium Corp. could change over to the use of the ilmenite?

Mr. WARTMAN. You have to define the conditions about which you are speaking there. You see, there have been for a number of years attempts to beneficiate ilmenite. I think some of the earlier ones depended on partial reduction—ilmenite is a combination of iron

and titanium oxide and the early work depended on the reduction of the iron part of the molecule to metallic iron and treating it with acid to dissolve it out and get a synthetic rutile.

In any beneficiation of ilmenite the main objective is to get out the things other than TiO_2 as quickly as possible so as to make the chlorination equipment smaller and simpler.

That was the first one that has been proposed. It, of course, has the disadvantage that it takes acid and one gets iron chloride or iron sulfate which is of no earthly use. Then I think the next major advance is the smelting operation up in the Canadian deposits to get the so-called sorrel slag.

That is admirably suited to the making of pigment and is principally slanted in that direction. Their primary objective is to make a slag high in TiO_2, which is acid soluble, to be converted into pigment.

It has the objection so far as chlorination goes that in order to get rid of the iron they substitute some other material which would consume chlorine and which would be a residue in the chlorinator, and which would introduce certain mechanical difficulties.

The latest work which has been done at the Albany station of the Bureau according to various patent reports by some of the operating companies is to try to devise a technique for smelting ilmenite in the electric furnace in such a way that the iron is reduced to metal and is reduced as a separate phase of metallic iron which can be drained off in a useful form and leaves a high TiO_2 slag to which no flux has been added and consequently which does not have an increased amount of material which will take up chlorine. So now when you say that you could convert to the use of ilmenite it depends on just what you mean by "convert." It would be quite possible to simply chlorinate ilmenite in the place of rutile.

Senator MALONE. More expensive?

Mr. WARTMAN. It would put a greater load—any iron that is in the feed to the chlorinators comes out as a sludge of iron chloride and it would mean providing greater sludge-reclaiming facilities. Of course, it would be more expensive because the iron would use up chlorine. In conversion you may mean converting to sorrel slag or it may mean actually smelting and making a high TiO_2 slag with no additional flux which would virtually mean no change in the present equipment.

It would mean putting in smelting facilities for the slag.

Senator MALONE. I think you have probably given us a very good technical explanation of it and I think we understand the trend. The subcommittee's purpose in conducting the further investigations is to assist wherever possible in bringing about the use of domestic materials instead of materials which have to be shipped across a major ocean in the manufacture of strategic and critical materials, simply because it has been established that the rutile we are getting from Australia would not be available the next morning after war started, and neither would the ilmenite we are now getting from India. So your work in perfecting the Kroll process, in my opinion, can result in a very valuable contribution.

You think the time element would be—how long did you say before you might get definite results?

Mr. WARTMAN. We see no reason why we could not get definite results within the 2 years allotted, maybe less. It depends on how things break.

Senator MALONE. Now, your contract for the manufacture of titanium has definitely terminated. You are not in that business any more.

Mr. WARTMAN. No, the committee on reorganization of the Bureau, which I believe was due to some joint committee of Congress, recommended very specifically that the Bureau get out of actual production operations unless they were essential to national defense and it seems that at the present time, at least, actual operation of our facilities there for production is not necessary and to a considerable extent they interfere with our regular investigative work.

Senator MALONE. Of course, that is a very definite point and an important point. I asked about that when I was here before.

Some of us have been perturbed that there might be a trend of cutting down on the work here, but is there any indication that the work will be cut below what it was before you went into the manufacturing business?

Mr. WARTMAN. Yes, both the contribution of the Ordnance Corps and the regular Bureau funds have been reduced somewhat.

That is, 30 or 40 percent.

Senator MALONE. That means a reduction in personnel?

Mr. WARTMAN. No, sir.

Well, I will have to amend my figure somewhat. The figures I gave you for the reduction of force due to termination of the production facilities also included a certain amount of reduction due to the reduction of the regular appropriation. We had started last year actively on this proposed program of chlorination and ilmenite beneficiation and that was just going good at the end of the year when it was necessary to drop it and let those men out.

Senator MALONE. Now., Mr. Wartman, your testimony will be mailed to you and if you have any additions to your testimony for completeness or accuracy, you make make them.

Your testimony before was very important. Your work has been important. I was glad to see it recognized by the Secretary of the Interior by presenting a little token of recognition of your work. So if you have nothing further to offer, we will thank you very much for your appearance.

Mr. WARTMAN. Thank you, sir.

Senator MALONE. Now we have Mr. Rowley here who is the general manager or president of the Titanium Corp. Mr. Rowley, will you come forward? If you have anyone you would like to bring with you, just have them come up and sit with you.

Mr. Rowley, will you identify yourself for the committee and give us a résumé in your own way of what improvements have taken place in your operation here since we were last in Henderson and what the future holds in your opinion for the manufacture of the product here and the general picture of the industry if you care to.

STATEMENT OF E. R. ROWLEY, PRESIDENT, TITANIUM METALS CORPORATION OF AMERICA, HENDERSON, NEV.

Mr. ROWLEY. I will be glad to.

My name is E. R. Rowley, president of Titanium Metals Corporation of America.

INCREASED PRODUCTION OF TITANIUM

I believe when you held hearings here last fall that we were operating in the range of 3½ to 4 tons a day. It was bringing down its Brinell hardness from a contractual limit of 224 which was too high for requirements of the industry. In this past year we have increased that production from 3½ to 4 tons to 10 tons a day, achieved in September, at a quality level of approximately 150 Brinell.

It required some extensive changes in equipment and a great deal of hard work, for which I think the boys should be complimented.

We know that that is not the end of the rope, that there can be still further quality improvements made. Tonnagewise we felt it was not wise to ask for more tonnage until we had chewed up what we had bitten off. That had been quite a problem.

We feel now and have entered a proposal to GSA that we should expand this Henderson plant by approximately 15 tons a day to a total of 25 tons a day or 9,000 tons a year.

That proposal was only submitted this week, so I hope it will receive favorable consideration from GSA.

Senator MALONE. I think the appearance of Mr. Gumbel here today makes it clear they are making every effort to meet the amount of production that has been laid down by the Office of Defense Mobilization, and I think this matter of increase in production here or elsewhere where companies have met their contract would be a question of meeting of the minds on a new contract. I hope there is not too much delay. Go right ahead.

Mr. ROWLEY. We feel there is some natural advantages to an expansion of a plant. You should get lower cost material by expanding a plant than by building a new one of identical capacity. We have available some of the capital investment that would not have to be duplicated and this plant should be reasonably low in capital cost per ton of titanium.

Senator MALONE. I suppose the overhead in management and general direction of a 25-ton plant would not be increased in proportion to the increased production either, would it?

Mr. ROWLEY. No; it would not. It should be. It will have to be increased, but not in the same proportion. And the know-how that has been built up over the years should make it go into operation more quickly than might happen with a new crew.

Senator MALONE. What do you estimate for the time limit? Suppose you were granted in the immediate future a 15-ton additional contract. How soon do you think you would be producing 25 tons a day?

Mr. ROWLEY. We would estimate 24 months from the signing of the contract with the probability that we could get some additional tonnage after approximately a year. We have not yet determined just what that intermediate tonnage increment would be.

Senator MALONE. Now, you have heard the testimony today; you know in general the objectives of the committee. We are only interested in the availability of this material. There is nothing you can do to increase your capacity until you get a contract, is there?

Mr. ROWLEY. Very little. We have the possibility of skidding over somewhat as you would expect in any plant. Today, going beyond our present capacity to any considerable extent would require

some ability to dispose of the sponge, a stockpiling provision, or revolving fund provision.

Senator MALONE. Anything that there is not a ready market for now within your contract the General Services Administration now takes for storage?

Mr. ROWLEY. Yes, sir.

POWER REQUIREMENTS FOR INCREASED TITANIUM PRODUCTION

Senator MALONE. Now give the committee the benefits of your advice as to what you need, if anything, in addition to the contract to go into this additional production. Do you have the facilities and power and water and everything necessary to do the job?

Mr. ROWLEY. We would require considerably more power than we now have available.

Senator MALONE. Tell the committee, if you can, briefly the amount of power you are using, what it amounts to in kilowatt-hours per pound or per ton, and what power you have available, what you would need in your estimate if you took the contract in 1955 and 1956 which would be the 2 years approximately consumed in reaching the capacity.

Mr. ROWLEY. We have available now through a contract with the Colorado River Commission some 150 million kilowatt-hours; 20,000 kilowatts.

We need about three quarters of that for our present operation. Expanded operations would require a total of 300 million kilowatt-hours and 40,000 kilowatts.

Senator MALONE. Where would you get this power?

Mr. ROWLEY. We have not nailed that down because we have not yet made any firm commitments for the expansion or had any firm commitments offered to us. There are several possibilities as I understand them. One, the possibility of Shasta Power; two, the possibility of some standby or some peak, I should say, not firm, Arizona power; three, the possibility of some steam-generated power from local utilities; the fourth possibility would have to be a plant of our own.

They are not in order of desirability or of economics. We would like, of course, to get the power at the most economic figure. That would be the ultimate objective.

Senator MALONE. This steam plant of the local power company—that is, the local power company that serves the Las Vegas area—is a contemplated plant. Is that construction started?

Mr. ROWLEY. I know the equipment is contracted for. A specific date has been set for completion.

Senator MALONE. There is a serious intention to build such a plant?

Mr. ROWLEY. Definitely.

Senator MALONE. Tell us about this Arizona Power that has been available. We also have available here today officials from the Arizona Power Co. and we intend to hear them as to what type power this is, but what is your judgment from what you know about it?

Mr. ROWLEY. I am not too competent to speak about that, Senator. We had a survey made some considerable time ago which has lain dormant since and it is available for a certain period of the year. I think it is in the winter.

Senator MALONE. Has it changed since the evidence was presented before the committee last year?

Mr. ROWLEY. Not to my knowledge. We have not resurveyed it and I would hesitate to say.

Senator MALONE. My remembrance of the testimony and it will be in the testimony itself, is that the power that was offered was secondary power to the extent that it was available only in certain months of the year, winter months, and in varying amounts and then a clause in the contract that if and when they required the power for their own use your contract would be terminated. Is that about the way you remember it?

Mr. ROWLEY. I know the first part and I believe the second part, too. I think it would be better to verify it.

Senator MALONE. We will verify it. I wanted the record to show that is approximately the testimony of last year.

Now we intend to have testimony here from the other manufacturers in the area and what we would like, of course, would be the testimony of these companies as to what they are now using, their probable demand for 1955, 1956, 1957 as far ahead as they can see any expansion which, of course, again depends in large measure on contracts or demand in the area itself and perhaps to a considerable extent on the availability of additional contracts just as you have offered to make with the General Services Administration.

So again we are facing the situation and have for several years here. You cannot take the contracts without the additional power, assurance that you can get it, of a type you can use and you cannot contract for the power until you have the contracts to utilize it. Therefore, there is a gap there that must be filled and the committee is trying to be helpful to the extent of bringing together the demand and the contracts whenever feasible.

Mr. ROWLEY. I would like to add if I may, that in addition to these power requirements I have mentioned for Titanium Metals Corp. of America there would be additional power requirements for the chlorine production that would be necessary for that expansion.

Not only would Titanium Metals Corp. of America need more power, but Stauffer Chemical Co., which would supply that chlorine, would also require more power.

Senator MALONE. In other words, looking ahead, say, 4 years or 5 years which is not very long to look ahead when you are talking about availability of power, if you are able to fulfill your 15-ton-a-day contract within 2 years and the record of testimony proves to be correct over a period of a year and a half before this committee we still need more titanium. We have not yet reached 150,000 tons a year. Is there any reason why an additional contract could not be taken then?

Mr. ROWLEY. No, sir; there is no reason and we would like, of course, to continue to grow in the titanium metal business. Both our parent companies have a record of wanting to do such things annd we now have half of the sponge capacity.

I do not know if it would be wise for us to have half of the 150,000 tons but we would not like to stop at 9,000.

It is a logical consideration to expand the plant up to some given size rather than build new plants. I would think that 9,000 tons would not be our limit here.

Senator MALONE. Then isn't it advantageous to look ahead in this power and if you took an additional 15 tons per day, we will say, in 1957 or latter part of 1956, then you would need half again as much power as you use now for this 15 tons per day?

Mr. ROWLEY. We would need half again as much. We would need again as much as we have available. We have a contract for 150,000. We would need another 150,000. At the end of that period of time or sooner, with titanium demand continuing to grow as it will, we would like to take another bite at growth.

Senator MALONE. Could you take this testimony of yours which will be returned to you and project your operations for say 5 years in the future providing the opportunity offered?

Mr. ROWLEY. Would be glad to and I can also give some figures and these could be calculated from this testimony today, the kilowatt-hours and kilowatts per ton of annual capacity.

Senator MALONE. What is the requirement in kilowatt-hours per pound or kilowatt-hours per ton, however you have it in your mind?

Mr. ROWLEY. That has to be qualified to some extent. There is not a clear-cut answer.

Senator MALONE. I understand that.

Mr. ROWLEY. I would say between 20 and 25 kilowatt-hours per pound of titanium metal if you add in all the power that has gone into the chlorine and magnesium.

Senator MALONE. Omit chlorine because we can take that up under another heading in another company, merely the manufacture of titanium.

Mr. ROWLEY. Just our power requirement here without counting in Dow, who is the only producer of magnesium in the country. They put in power that we buy in ingot magnesium form here.

Senator MALONE. Yes.

Mr. ROWLEY. It is approximately 15 kilowatt-hours per pound.

Senator MALONE. What is it for the magnesium requirement in kilowatt-hours, approximately?

Mr. ROWLEY. It is roughly 10 to 12 kilowatt-hours per pound of magnesium.

Senator MALONE. How much magnesium for each pound of titanium?

Mr. ROWLEY. One for one theoretically. That is not attainable. It will vary. I think 1¼ is a fair figure. Mr. Wartman could answer that.

Senator MALONE. That would be 25 kilowatt-hours in itself or more?

Mr. ROWLEY. My 15 kilowatt-hours include recycling some magnesium.

We do not have to buy the whole pound and a quarter.

Senator MALONE. It does not amount to that, it is less than a pound including the recycling.

Mr. ROWLEY. We do not buy a pound of magnesium for each pound of titanium we make.

Senator MALONE. It is like scrap metal. If you can reuse it——

Mr. ROWLEY. We not only recycle the magnesium but we also recycle the chlorine.

Senator MALONE. What percentage of the chlorine and magnesium?

Mr. ROWLEY. We consider that confidential information.

Senator MALONE. You can complete your testimony. The question will be there, and for accuracy and completeness.

Mr. ROWLEY. I think almost any good chemical engineer can calculate how much of the magnesium and how much of the chlorine would be recovered. It should be something on the order of two-thirds of each.

Senator MALONE. You can round our your testimony in that regard.

Mr. ROWLEY. Mr. Wardman calculated that many times.

Senator MALONE. What other products, if any, besides magnesium and chlorine do you buy in the manufacture of titanium that you do not manufacture yourself or produce?

Mr. ROWLEY. We buy our titanium-bearing raw material, which is rutile.

Senator MALONE. From Australia?

Mr. ROWLEY. Yes, sir.

Senator MALONE. The raw material, then magnesium and chlorine are the only purchases you make outside of your own company?

Mr. ROWLEY. We buy some chemical reagents that are peculiar to our operation. I would rather not talk about them. They can be procured rather readily and, of course, we have the usual maintenance materials which, in this process, are relatively costly but not difficult to procure.

Senator MALONE. This magnesium is purchased by Dow Chemical at a distant plant. Where is that plant from which you purchase the magnesium?

Mr. ROWLEY. I believe Dow makes magnesium at Freeport and Velasco, Tex.

Senator MALONE. Chlorine is the only product you purchase in the area here?

Mr. ROWLEY. We do purchase some caustic soda here which is made at the same time that chlorine is made.

Senator MALONE. By the same company?

Mr. ROWLEY. By the same company. And one of our reagents is purchased here also, hydrochloric acid.

Senator MALONE. If you will complete your testimony along the lines there indicated, we will appreciate it.

Now, is there anything else that you would like to offer for the benefit of the committee?

Mr. ROWLEY. Only to say that we certainly have unlimited confidence in this metal and in its future. I would like to make one generalization that I keep in my mind all the time, which is that I think the company that uses the most titanium most intelligently in an airframe or engine is quite likely to have a big jump on the other fellow.

Senator MALONE. The testimony of all of the producers practically corroborates that conclusion. There is always a question as to who should take the lead in making this material available.

Now you have heard the testimony of Mr. Wartman that they are going to experiment here in use of ilmenite in the place of rutile and the transfer of the manufacture from rutile to ilmenite. What do you have in mind in that regard?

Mr. ROWLEY. We, too, are working on that and intend to continue on it. When we talk about a few thousand tons of titanium a year, with the process so new to us, we wanted to concentrate on those things

specific to titanium, so it was the simplest thing to do to chlorinate rutile.

As the program grows there may not be that much rutile available. The bulk of what is available is from foreign shores. It is not a sensible thing to hang business for national defense or even private business on something like that. So our intention is—and we have been doing some work and are stepping up the tempo of it—to develop the ability to produce titanium tetrachloride from ilmenite and when you say that you say from a North American raw material because there is almost unlimited quantities available on the North American Continent.

Senator MALONE. We are glad to hear you say that. It is a source of worry to the subcommittee that we are dependent on foreign sources for so many materials.

Give us an idea again all in one statement of the number of kilowatt-hours that you are now using and what you would need with the additional 15 tons per day and then additional 15 tons after that period.

Mr. ROWLEY. For our present 10 tons a day we use approximately 15,000 kilowatts and 110 million kilowatt-hours. For 25 tons that we are projecting we would require approximately thirty-five to forty thousand kilowatts and 300 million kilowatt-hours per year. We require 4,000 kilowatts per thousand tons of annual capacity and just over 30 million kilowatt-hours per thousand tons of annual capacity.

Senator MALONE. I think that is very helpful.

I would like to insert in the record at this point a table—Comparison of estimated annual power use month of September 1954.

These figures are subject to correction after the testimony is available.

(The comparison follows:)

Comparison of estimated and actual power use, month of September 1954

Contractor	Kilowatt-hour use for this month				Accumulated use—through this month			
	Estimate	Actual	Above estimate	Below estimate	Estimate	Actual	Above estimate	Below estimate
Basic Management	2,570,000	3,376,501	806,501		11,030,000	13,744,840	2,714,840	
Cal-Pacific Utilities	1,700,000	1,566,459		133,541	6,700,000	6,483,640		216,320
Combined Metals	7,100,000	6,475,361		624,639	28,800,000	22,714,168		6,085,836
Manganese, Inc	2,500,000	2,060,373		439,627	8,740,000	8,128,442		611,558
National Lead	9,200,000	7,781,349		1,418,651	27,800,000	29,003,111	1,203,111	
Stauffer Chemical	17,400,000	15,290,889		2,109,111	65,260,000	63,198,905		2,061,095
United States Lime	460,000	420,185		39,815	1,840,000	1,869,046	29,046	
Western Electrochemical	15,000,000	13,298,221		1,701,779	60,000,000	50,922,057		9,077,943
Total BMP	55,930,000	50,269,338	806,501	6,467,163	210,170,000	196,064,209	3,946,997	18,052,788
			5,660,662				14,105,791	
Lincoln County	3,000,000	2,108,084		891,916	11,000,000	8,817,768		2,182,232
Overton Power District	710,000	735,089	25,089		2,800,000	2,918,573	118,573	
Southern Nevada Power Co	26,500,000	26,638,600	138,600		108,730,000	110,236,129	1,506,129	
Total, southern Nevada contractors	30,210,000	29,481,773	163,689	891,916	122,530,000	121,972,470	1,624,702	2,182,232
			728,227				557,530	
Total State	86,140,000	79,751,111	970,190	7,359,079	332,700,000	318,036,679	14,663,321	
			6,388,889					

Senator MALONE. We thank you very much, Mr. Rowley, for your appearance.

Mr. ROWLEY. Thank you, Senator.

Senator MALONE. Mr. Art Newell is the works manager of the Stauffer Co. Mr. Newell, will you identify yourself for the record. We are leaning heavily on you as well as the other companies here. You have had long experience in the area and you know what is necessary in a general way for the expansion of the area.

The Stauffer Co. has been very important in the products it has produced for other companies such as Titanium Corp.

You, also have contracts that apply to national defense. Some maybe you can mention, some maybe you cannot. But if you could give us an idea of the power you are now using, the power you have under contract. You have heard the possible growth of the area as far as titanium is concerned and your part in it, if you could give us some idea of what you could project for, what you are using in 1954, what you project in 1955, 1956, 1957 and then as far in the future as you conveniently can, the committee would appreciate it.

STATEMENT OF ART NEWELL, WORKS MANAGER, STAUFFER CO., HENDERSON, NEV.

Mr. NEWELL. Thank you, Senator. I am Arthur Newell, works manager for the Stauffer Chemical Co. of Nevada.

Senator, I have with me Mr. Roy Martindale, who is our power consultant.

Senator MALONE. Mr. Martindale gave us very informative testimony at our last hearing.

Give your initials to the reporter.

Mr. MARTINDALE. Roy Martindale, consulting engineer.

Senator MALONE. You are from?

Mr. MARTINDALE. Sunland, Calif.

Senator MALONE. Now, go ahead, Mr. Newell.

Mr. NEWELL. Senator, as Mr. Rowley has already told you, we furnish them with the necessary chlorine which they use for the production of titanium metal at the present time. He has also indicated to you that we furnish them some caustic soda and some hydrochloric acid. Those chiefly are the products that they take from the Stauffer Chemical Co.

I would like to say that our company has indicated that it is willing to do everything possible to expand their production to take care of the increase in requirements of chlorine and other chemicals, to allow the Titanium Metals to reach the capacity of 25 tons and I assume when that is reached, as Mr. Rowley has indicated, they decide they want to go further, that Stauffer will be interested in keeping pace with that development.

Senator MALONE. You may submit anything for the record, any figures or tables you care to.

Mr. NEWELL. I will be glad to submit some written papers here to your secretary and you can use what you like for them.

Senator MALONE. Just submit them as you go along, if you care to.

Mr. NEWELL. I will hand them to him.

I would like to say that our power requirements—I will go back a step further to say just for the record that our products at this plant are chlorine, caustic soda, benzene hexachloride, insecticide DDT raw materials which are chloral and monochlorbenzene and hydrochloric acid.

The principal raw materials which we are using are salt, we use approximately 10,000 tons a month at the present time, alcohol, benzene, power about 18 million kilowatt-hours scheduled for November, water in the amounts of 120 to 130 million gallons per month, natural gas. 50 to 60 million cubic feet per month.

Senator MALONE. Is this the record at present?

Mr. NEWELL. Yes, sir.

Senator MALONE. Make some estimate, if you care to, as to the future.

Mr. NEWELL. We anticipate that by 1956, 1957, to take care of titanium requirements plus other requirements of our own that the power requirements will have expanded to approximately 367 million kilowatt-hours per year. We have on firm contract from the Colorado River Commission 139 million kilowatt-hours which leaves 229 million kilowatt-hours we shall have to draw from other sources.

Those sources which may be available to us are Arizona, steam power from Arizona, especially in the wintertime. There is, as Mr. Martindale may point out, the possibility of steam power from southern California in the summertime. There is the possibility of Shasta power in southern California and there is a good likelihood there may be power available from the Southern Nevada Power Co. as they add additional units. The fact was brought out that one unit was being installed, would be installed in the immediate future and would be ready perhaps by January 1, 1956.

I understand that Southern Nevada Power has under consideration the possibility of adding additional units and also perhaps larger units if the demand in this area is sufficient.

I think that if we have to expand here to take care of the chlorine requirements for titanium metals and for additional Stauffer customers, that we will be faced with a considerable expansion in plant. We will be faced not only with securing additional power for our requirements here but we will be faced with the problem—and this is probably opposite to what you are usually required to do—find a sale for some additional caustic. We will have something like 40,000 tons of additional caustic annually to dispose of.

Senator MALONE. On account of the demand for chlorine?

Mr. NEWELL. Right, because of the stepup of chlorine demand.

We are finding some additional usage for caustic soda in the mining industry and we are trying to develop all the markets we can on the coast but we may be faced with the sale of a lot of caustic we do not know now just what we will do with.

I do not know of much else that I can add to this picture right at the moment. I think it has been pretty well covered in the earlier statements.

Senator MALONE. Would you like to submit your tables for the record?

Mr. NEWELL. Yes, sir.

(The tables follow:)

STAUFFER CHEMICAL CO. OF NEVADA,
Henderson, Nev., October 22, 1954.

Re Stauffer Chemical Co. of Nevada, Henderson, Nev.

Hon. GEORGE MALONE,
United States Senator for Nevada,
Washington, D. C.

DEAR SENATOR MALONE: The Stauffer Chemical Co. of Nevada and its affiliate, the Montrose Chemical Corp. of California, manufacture at Henderson the following:

Products

Chlorine
Caustic soda
Benzene hexachloride insecticide
DDT intermediates
(*a*) Chloral
(*b*) Monochlorbenzene
Hydrochloric acid

Principal raw materials used

Salt—10,000 tons per month
Alcohol
Benzene
Power—18 million kilowatt-hours per month, November 1954
Water—120–130 million gallons per month
Natural gas—50–60 million cubic feet per month

Uses of products

(*a*) Chlorine:
Manufacture of BHC, DDT intermediates
Benzene hexachloride
Hydrochloric acid
Titanium tetrachloride
Household bleach
Water treatment
Sewage treatment
Swimming pools
Manufacture of other chemicals

Between 80 and 90 percent of the chlorine manufactured here is used on the project.

(*b*) Caustic soda—5,000 to 6,000 tons per month:
Manufacture of steel
Oil refining
Soaps and detergents
Meat packers
Vegetable oil processing
Mineral processing (includes uranium, tungsten, and titanium)
Food products (olives)
Water softening
Other chemicals

(*c*) Benzene hexachloride:
Insecticides, particularly for boll weevil in cotton areas

(*d*) DDT intermediates:
Chloral and monochlorbenzene are further processed on the Pacific coast to finished DDT.

(*e*) Hydrochloric acid—4,000 tons per month:
Manufacture of jet fuels (ammonium perchlorate)
Mineral and metal processing, particularly molybdenum, tungsten, titanium
Food products processing
Disinfectants
Other chemicals

Power requirements

Stauffer's power requirements have grown from 91,400,000 kilowatt-hours for the power year 1945–46 to an estimated 211,500,000 kilowatt-hours for the power year 1954–55.

	Present operation (1954–55)	Projected operation (1956–57)
Kilowatt-hours per year	211,500,000	367,800,000
Kilowatt-hours contract	139,000,000	139,000,000
Balance required	72,500,000	228,800,000

Additional power over contract is now being obtained from unused pool power plus steam power from Arizona.

Possible near future sources may come from one or more of the following: (*a*) Arizona, (*b*) California, (*c*) Southern Nevada Power Co.

For Stauffer, power represents approximately 20 percent of the total cost of chlorine and caustic, hence, it must be obtained at a reasonable price to be competitive with manufacturers in other localities.

It should be pointed out that to reach the expansion indicated above an investment of approximately $10 million will be required.

One of our major problems will be to dispose of the additional caustic manufactured—amounting to some 42,000 tons per year.

Yours very truly,

A. T. NEWELL, *Works Manager.*

Senator MALONE. Now what part, without going into anything that may be classified information—I understand you do have certain contracts, at least your part of the manufacture of chlorine and the caustic soda they use in titanium would be a national defense use—what part of your power would you say is used or allocated that could probably be called national defense industry finding its way into national defense?

Mr. NEWELL. Well, as strictly national defense contracts with the Federal Government I would say that we cannot label those as such. Our products find their way into other factories and to other uses which go directly for national defense.

Senator MALONE. I did not mean that you make direct contracts with the Government but your chlorine goes into the manufacture of titanium and the Titanium Corp. have the contracts?

Mr. NEWELL. That is right.

Senator MALONE. What percentage would you say of the power you use is used to manufacture products that do go into national defense?

Mr. NEWELL. Insofar as titanium is concerned, I would say roughly 20 to 25 percent of power, our power, would go for that purpose.

Senator MALONE. For the chlorine and caustic soda?

Mr. NEWELL. Yes, and for hydrochloric acid which is not always a byproduct but must be manufactured by burning chlorine and hydrogen.

Senator MALONE. What other product goes in as an end product to the support of national defense?

Mr. NEWELL. May I answer that by telling you the use of our products. The chlorine is used for manufacturing benzene hexachloride which is a DDT intermediate; for hydrochloric acid; titanium tetrachloride; household bleach; water treatment; sewage treatment; swimming pools; manufacture of a number of chemicals.

The caustic soda which we produce at the same time goes into the manufacture of steel; into oil refining and especially for the production of high octane gas; for soaps and detergents; for meat packers; vegetable oil processing; mineral processing, particularly uranium; tungsten; and titanium. It goes into various food products like processing of olives, water softening and for manufacturing a great number of other chemicals.

Senator MALONE. You could say roughly maybe 90 percent or more of the power, the end product is in the support of national defense. Petroleum would be classified as national defense because one of the worries which, I think, is past now, is having a reserve capacity in the production of petroleum for war.

Mr. NEWELL. That is correct.

Senator MALONE. Now, without these products the manufacture of the end product of petroleum would be impossible, would it not?

Mr. NEWELL. That is right.

Senator MALONE. What would you say, then, the percentage of your power supply reaching that end product necessary in national defense could be properly allocated in that category?

Mr. NEWELL. I should say that probably 75 percent of it at least might be allocated to that.

I think you have contributed a great deal to our record; and, if you will, when the record reaches you, round it out for accuracy and completeness, we will appreciate it very much.

Mr. NEWELL. Thank you. If you have any technical questions for Mr. Martindale, he will answer them.

Senator MALONE. Mr. Martindale has heard my remarks, and his comment in that connection would be interesting for the record. We are simply trying to find out what is the national-defense requirement for power in this area, and, of course, the additional demand.

STATEMENT OF ROY MARTINDALE, POWER CONSULTANT, STAUFFER CO.

Mr. MARTINDALE. I might add in addition to what I testified last year that practically all the present planned development in California and I believe in Arizona is from steam. There is very little more hydro available to this area except that that you have mentioned in the development of the upper river.

At the present time the surplus of power in what we call the general power pools available to this area is possibly not more than 15 percent and will be somewhat improved not in 1955 but in 1956 from present plants that are contemplated.

Senator MALONE. You are aware that the Colorado River Commission of Nevada has application in good standing for 90,000 kilowatts of power from Shasta Dam?

Mr. MARTINDALE. Yes, sir.

Senator MALONE. And it is of long standing. Now, there has been some difference of opinion as to how it could be made available.

I think you testified before there is no question but what it could be available if the spirit is there to make it available in this area and in the Reno area, northern Nevada.

It is simply a question of the proper demand. Do I remember correctly that that is about what you testified?

Mr. MARTINDALE. It is a question of feasibility, the facilities and transmission lines would probably take it in the event of war emergency. In peacetime it is pretty much a question of feasibility.

Senator MALONE. Well, have you made any study of the feasibility?

Mr. MARTINDALE. I have not.

Senator MALONE. We are all aware of the feasibility factor.

Mr. MARTINDALE. It would depend on what the wheeling charges and losses might be.

I mentioned last year, I think, in my testimony, there were 2 ways of getting energy to this area by transfer and that still holds, those 2 ways are still available.

Senator MALONE. Give us the benefits of a review of the two ways.

Mr. MARTINDALE. I have to go back and refresh my memory but one was through the transfer of power to the city of Los Angeles and water replacement in Lake Meade, and the other was through the Edison company possibly the Metropolitan Water District exchanging water through that method.

Both of them are physically possible but they have to make specific arrangement to do it. Both would involve, I presume, losses to some extent and wheeling charges and I do not know what that would be.

Mr. NEWELL. May I ask a question? Do you know what the production cost of power is at Shasta at the present time? Is it 3 mills?

Senator MALONE. I do not know exactly what it is but that is ascertainable.

I do not think it has changed any.

Mr. MARTINDALE. I think it is on the order of 4½ to 5 mills. That is why I mentioned economic feasibility. If that is not true, it might readily go out of the feasibility field.

Senator MALONE. Naturally you talk about feasibility, but, for example, it is not feasible to take the basic investment of Titanium Corp. and base it on power in an area on 2 counts, 1 that you get it in the winter months in varying amounts and the other 1, you do not get it at all if you happen to need it.

You would not recommend an investment on that basis, would you, as an engineer unless you had another source?

Mr. NEWELL. Senator, aren't we talking about in the final analysis what the laid-down cost is here? We are talking about two things, the laid-down cost, and the availability.

If it costs more to bring power from Shasta here than we can buy it for from Southern Nevada Power or from Arizona or from a combination of these three then it is not feasible, as I understand it; if we can get it for less we ought to go after it.

Senator MALONE. That is right. But there is one more factor. When you get firm power from an investment that is already made, then the price fixing will not change over 5, 10, 15, or 20 years. You have got something you can put an investment upon, but when you get power from Arizona or Southern Nevada Power Co. or others where it is subject to change with the cost of fuel or any other conditions, labor and all, you are not very happy.

Mr. NEWELL. You are perfectly right.

Senator MALONE. There will never be another 2 mills per kilowatt-hour in a large project in the United States such as right down here under your noses.

That completes the hearing for today and the subcommittee will stand in recess until 9 o'clock in the morning.

(At 7:20 p. m. the hearing was recessed until 9 a. m., Saturday, October 23, 1954.)

STOCKPILE AND ACCESSIBILITY OF STRATEGIC AND CRITICAL MATERIALS TO THE UNITED STATES IN TIME OF WAR

SATURDAY, OCTOBER 23, 1954

UNITED STATES SENATE,
MINERALS, MATERIALS AND FUELS ECONOMIC SUBCOMMITTEE
OF THE COMMITTEE ON INTERIOR AND INSULAR AFFAIRS,
Henderson, Nev.

The subcommittee met at 9 a. m. in the Colorado River Water Commission offices, Henderson, Nev., Senator George Malone presiding.

Present: Senators George Malone (presiding) and Ernest Brown.

Also present: Jerome Adlerman, counsel; Arthur M. Smith, administrative assistant to Senator Malone.

Senator MALONE. The committee will be in order. I guess 9 o'clock was a little early for some of the boys. We would not hold it this morning in view of the other things going on but the committee has hearings starting on Monday in Reno on the Truckee-Carson project and therefore it is necessary for the chairman to get away at noon. If we have not quite finished when I have to leave at about 11:15, Senator Brown will be here to complete the hearings and Mr. Adlerman, the counsel, and Mr. Smith, my administrative assistant will stay to the end. I do not believe it will be long this afternoon.

STATEMENT OF HAROLD J. STOCKER, LAS VEGAS, NEV., ACCOMPANIED BY PAUL O. DRURY

Mr. STOCKER. My name is Harold J. Stocker, 1201 Freemont, Las Vegas, Nev.

Mr. DRURY. I am Paul Drury, Las Vegas. I was one of the incorporators of Aero Metals Corp., and president of it for its approximate first 6 months of being. Subsequently I terminated any connection with them and found that Mr. Stocker had been in connection with the Shawinigan Water & Power Co., had made several trips to Montreal and Shawinigan Falls, Quebec, and had succeeded in having a working agreement with them and conference between Mr. J. A. Fuller, the president, and Mr. Norman R. Fasken, the director of research department and Mr. Phillip S. Gregory, the chairman of the board and that negotiation resulted in the possibility of eventually some agreement being made with Mr. Stocker tending toward a mutual agreement. Subsequent to my withdrawing from the Aero Metals he approached me and we took up the matter with Shawinigan at July 22. We have this letter from them which I can make a part of the record.

(The letter follows.)

THE SHAWINIGAN WATER & POWER CO.,
Shawinigan Falls, Quebec, July 22, 1954.

MR. PAUL O. DRURY,
Las Vegas, Nev.

DEAR MR. DRURY: I certainly was surprised and interested to learn from your letter of July the 14th, that you are no longer president of Aero Metals Corp. You are to be congratulated on guiding this company through to the negotiation stage for a contract with the United States Government re titanium metal.

As you already know the process which we are developing for the electrolytic production of titanium metal has yet to go through the pilot-plant stage. Therefore we are not at this time able to make any firm estimates on production costs for this new process or what would the necessary volume be to warrant setting up a plant. We hope that these next few months will give us this information.

Until this phase of the work is completed we are not forming any policies with regard to where the eventual plant would be set up or with regard to possible licensing of the process to others. When the time comes we shall certainly give your proposition every consideration.

At the present time patents covering our new process have not yet issued in Canada or the United States, therefore, we are not able to send you a copy thereof. However, the patent has issued in Great Britain under No. 678,807. You could undoubtedly obtain a copy of this by writing to the British patent office.

With best personal regards to yourself and Mr. Stocker, I am,

Yours very truly,

N. R. FASKEN,
Director, Research Department.

MR. DRURY. This gentleman refers to a new electrolytic process of obtaining titanium sponge from titanium tetrachloride and the plan envisioned was to utilize slag from sorrel in which the original memorandum stated that there were some 300 million tons in their dump at the present time and that they were producing daily 900 tons of slag which would be enough to produce about 150 tons per day of titanium sponge.

The next step in the matter was on September 1, a letter from Fasken dated September 1, 1954.

(The letter follows:)

THE SHAWINIGAN WATER & POWER CO.,
Shawinigan Falls, Quebec, September 1, 1954.

MR. PAUL O. DRURY,
Las Vegas, Nev.

DEAR MR. DRURY: Your letter of August the 21st was on my desk when I returned from holidays, hence the delay in answering it.

Since I wrote you over a month ago there have been some few further delays in getting our pilot plant started. However, we now have made a start but only in the tetrachloride producing sections. It will be a few weeks yet before the cell producing the metal itself will be in operation. However it will be sometime after that before there will be much in the way of additional information such as I believe you will be interested in. Pilot plants do not work and produce as quickly as apparently you expect.

As far as a visit by you and Mr. Stocker is concerned I will be very glad to have you come and see us. However, since writing you last the secrecy regulations imposed on this project have been tightened to some extent. I would suggest therefore in order that everything is in the clear that you obtain clearance to see this project. This would have to be obtained from the Department of Defense Production in Ottawa. I have no doubt that Mr. Stocker could arrange this through his connections with Senator Malone.

I will be looking forward seeing you and if you will let me know exactly when you are coming I shall appreciate it.

Yours very truly,

N. R. FASKEN, *Director Research Department.*

Mr. DRURY. We contacted Senator Malone's office and requested him to secure such clearance. That we have not gotten but we did get a letter or request by telephone from his secretary that we write Mr. Armstrong, assistant secretary of the Embassy of the Dominion of Canada and that letter we will put into the record.

(The letter follows:)

OCTOBER 4, 1954.

Mr. ARMSTRONG,
Assistant Secretary, Embassy of the Dominion of Canada,
Washington, D. C.

DEAR SIR: A short while ago, we requested the office of Senator George Malone to secure from your Embassy, the necessary blanks required to grant a defense clearance permit to deal with the Shawinigan Water & Power Co., and were advised by the Senator's office to contact you directly.

Mr. Harold J. Stocker, of 1201 Fremont Street, and I, 2101 South 10th Street, both of Las Vegas, Nev., desire permission of the Office of Defense Production of Canada to continue negotiations which have been under discussion for about a year with the Shawinigan Co. on the subject of titanium.

At various times, Mr. Stocker or I have been in touch, personally or by letter, with Mr. P. S. Gregory and Mr. N. R. Faskin, director, research department.

We understand from them that it is now necessary to have this clearance before making a visit to any of their plants, and we would appreciate your courtesy in facilitating this clearance as soon as possible.

Very truly yours,

PAUL O. DRURY.

Mr. DRURY. In answer to that, we had a letter from them, dated October 12, 1954.

(The letter follows:)

CANADA, DEPARTMENT OF DEFENCE PRODUCTION,
CLEVELAND PARK STATION,
Washington, D. C., October 12, 1954.

PAUL O. DRURY,
Real Estate Appraisals,
Las Vegas, Nev.

DEAR MR. DRURY: Reference is made to your letter of October 4, 1954, requesting clearance to visit the Shawinigan Water & Power Co., on behalf of yourself and Harold J. Stocker.

In accordance with the United States-Canada Industrial Security Agreement, all visit requests must be submitted through one of the United States services as it is necessary that they verify the security status of the persons who wish to visit Canadian industries.

In view of the above, your letter has been referred to the Chief, Foreign Liaison Branch, Directorate of Intelligence, USAF Headquarters, Room 4A912, The Pentagon, Washington, D. C. (attention Lt. Col. R. R. Catterlin).

Should hastening action become imperative, it is suggested that you contact Lieutenant Colonel Catterlin (Liberty 5-6700, extension 7-5296) direct.

Yours very truly,

E. R. ARMSTRONG
(For N. R. Chappell, Director).

Mr. DRURY. Whereupon we have already contacted Senator Malone, and Senator Brown is now in the picture and we have passed our problem on to him. He has contacted his Washington office, and that is the same personnel who served Senator Pat McCarran so ably, and they have taken over just as things stopped. We have from Senator Ernest S. Brown the following telegram, under date of October 21, which is yesterday, directed to Paul O. Drury, 2101 South 10th Street, Las Vegas:

Eva advises—

and then he refers to Mrs. Adams, of course, the late Senator McCarran's secretary—

Eva advises evidently confusion existing re security clearance Vegas parties. Government has no interest in activities of individuals, hence cannot give defense clearance permits to visit foreign plant having defense contracts unless individuals concerned can be sponsored by this Government as military agents. Then matter is on Government to Government basis. Evidently queries from other offices and seeming pressure has aroused curiosity as to need for visit prior to negotiating on commercial basis. Neither Government admits of any interest in any negotiation except as between military agents of each country. Pentagon asserts no file here as no consideration is being given under present circumstances. Respectfully suggest parties airmail full details and any information which would offset above contentions.

(Signed) ERNEST F. BROWN, *Senator.*

It has been the intent, I am sure, for quite a long time to facilitate private industry in the obtaining of a sufficient quantity of titanium, both sponge and ingot, or any other form that is necessary for the war effort or otherwise, and we are asking for your good graces in trying to expedite for us the means of obtaining a clearance so that we can go up and talk business with this plant with whom we have been in contact for nearly a year's time and from whom we find we are now barred from having contact with due to a security regulation required and which our United States Air Force says they find no reason for giving us any clearance or even looking into the matter.

Senator BROWN. Mr. Drury, I have brought this to the attention of Senator Malone as your Senator from Nevada and I wish to assure you on his behalf and myself that we have taken steps to do what can possibly be done to facilitate what you desire for the reason that we believe it is in the interest of national defense to the extent of getting the metals program moving as you have indicated.

Mr. DRURY. I would like to make one comment. Of course, it is entirely a new process over that which is currently in use by both Du Pont and Titanium Metals Corp. It is as far as we know a continuous electrolytic process which has gone through three pilot-plant stages and they are now operating at 20,000 amperes which is producing to our best information approximately 1 ton per day of very high quality sponge in the neighborhood of 100 Brinel test and conceivably sitting on top of a source of supply that is located here in America where we have no transportation problems in the event of war where they themselves, the Shawinigin Water & Power Co., assure us they have ample power not only to make titanium tetrachloride necessary but to make the ingot and the finished job.

Mr. ADLERMAN. As far as I know, there is no electrolytic process being used in this country, I think, except the office at Boulder or Bureau of Mines have a little experimental work on it.

Mr. DRURY. I am not sufficiently up on those matters. I do think that there have been several lines of effort to get into the problem through that road.

Mr. ADLERMAN. There is no commercial titanium being produced by that method at present?

Mr. DRURY. To the best of my knowledge; no.

Mr. ADLERMAN. All using some modifications of the Kroll system.

Mr. STOCKER. Union Carbide has applied for use of the Canadian patent.

Mr. ADLERMAN. This would be something new and different from what they are doing in the United States?

Mr. DRURY. It is a completely different approach.

Mr. STOCKER. This would not be done in the United States.

Mr. ADLERMAN. I suggest you incorporate whatever correspondence you think is important and we will put it in the record as an exhibit and then when we get to Washington we will see what can be done.

Mr. STOCKER. I talked to them on the telephone and they said come up anyway.

(Discussion was continued off the record.)

Senator BROWN. Thank you gentlemen very much.

Is there anybody else here who desires to testify? If not, the chairman wishes the committee meeting to be recessed until the call of the Chair.

Senator BROWN. We will be in recess.

(At 1:45 p. m. the subcommittee recessed subject to the call of the Chair.)

STOCKPILE AND ACCESSIBILITY OF STRATEGIC AND CRITICAL MATERIALS TO THE UNITED STATES IN TIME OF WAR

FRIDAY, NOVEMBER 19, 1954

UNITED STATES SENATE, SUBCOMMITTEE ON
MINERALS, MATERIALS, AND FUELS ECONOMICS OF
THE COMMITTEE ON INTERIOR AND INSULAR AFFAIRS,
Washington, D. C.

The subcommittee met, pursuant to recess, at 9 a. m. in room 224 Senate Office Building, Senator George W. Malone presiding.

Present: Senator Malone.

Present also: Jerome S. Adlerman, chief counsel; George B. Holderer, staff engineer; N. D. McSherry, chief clerk.

Senator MALONE. The committee will be in order.

STATEMENT OF THOMAS P. PIKE, ASSISTANT SECRETARY OF DEFENSE (SUPPLY AND LOGISTICS)

Senator MALONE. I am glad to see you, Mr. Pike.

Mr. PIKE. I am glad to be here, Senator.

Senator MALONE. Sometimes the chairman of the committees will not admit it, but they are woefully ignorant about things—simple things, and then sometimes it is very hard to get the information.

In 1953, the Senate passed Senate Resolution 143 that directed this committee to determine the accessibility of critical materials in time of war for our expanding economy and for our security. As a result of that resolution, this committee, then, had to determine the area that would be accesssible in time of war and then, within that area, see how self-sufficient we could become in securing what are known as critical materials.

It was determined then that the Western Hemisphere would be the only dependable source in the first go-around in the next world war.

But it seems wise to follow through to the last detail, as far as the committee is able, to determine the availability within this area that was agreed could be defended.

One of the many critical materials that we paid particular attention to was titanium because we had testimony that to make a long-range sonic speed plane, titaninum was needed because of its weight-strength ratio and heat-resistant qualities; that no known metal approaches it in the heat-resistant and weight-strength ratio.

So we asked you to come for a particular reason. It was determined that the Department of Defense had asked for 35,000 tons of titanium annually, at a time when not too much was known about the material.

The request was transmitted to the Office of Defense Mobilization, headed by Dr. Flemming. There it was cut to 22,500 tons.

We found that contracts for approximately 7,200 tons annually had been let to two companies, Titanium Corp., in Henderson, Nev.; and Du Pont, in New Jersey.

We found that approximately 2,000 tons annually were being manufactured, much of which did not meet the necessary specifications. It met original specifications in 200, 210 hardness, but there was not enough known about it at that time. Later it was determined to be 140, 150, 160, but it was not meeting the actual need. And on the contract for 10 tons per day at Henderson, 3¾ tons of the production met the specifications.

General Metzger, Chief of the Production Resources Division, Wright Field, was very helpful to the committee and testified that they could use 150,000 tons a year, if it were available.

Subsequent testimony from Donald Douglas, of Douglas Aircraft; Robert Gross, of Lockheed, and others confirmed that 150,000 would be a good start.

Then we thought our work was done in that commodity at least. But nothing happened. The Office of Defense Mobilization raised this estimate to 25,000 tons and directed the General Services Administration to contract for that amount. Well, they did speed them up.

So at least we know they are making some progress.

I would like to ask you what has been done and who is responsible in the Defense Department to determine really how much titanium is needed, and who is responsible for the 35,000 tons daily?

Mr. PIKE. Mr. Senator, I am very happy to have this chance to appear here before your committee this morning.

Senator MALONE. First, will you give us your full name, and title?

Mr. PIKE. My name is Thomas P. Pike, Assistant Secretary of Defense, Supply and Logistics.

Senator MALONE. That sounds very imposing.

Mr. PIKE. The big words there might be misleading. Let me explain just where I fit into this Department of Defense.

Senator MALONE. Please do.

Mr. PIKE. Senator, I am one of nine Assistant Secretaries of Defense established under Reorganization Plan No. 6. In that capacity I have no line authority from Secretary of Defense Wilson to the military services. Rather, that line flows directly from Secretary Wilson to each one of the secretaries of the military departments. The line goes from the Chiefs of Staff and on down the line in the three military departments.

However, I have the responsibility for advising the Secretary of Defense with respect to policies having to do with the supply and logistic phases of the programs of each one of the military departments.

More specifically, one of these responsibilities that we have in that capacity of staff adviser to Secretary Wilson is to gather from each one of the military departments their requirements for both end items and, where critical materials are involved, those quantities of the critical materials involved for both their current procurement programs and needs, as well as their mobilization indicated needs.

Our office, upon obtaining that information, then passes it on to Dr. Flemming's Office of Defense Mobilization, and he has the responsi-

bility for seeing to it that the proper capacity in titanium, for instance, is achieved, or that proper steps are taken to attempt to augment the sources of supply and stockpile of nickel and other critical materials.

Senator MALONE. You say that Mr. Wilson makes that decision himself. Do you advise him directly?

Mr. PIKE. That is correct. My position is strictly one of staff adviser to Secretary Wilson.

Senator MALONE. You are responsible to him and not to any Under Secretary?

Mr. PIKE. That is correct, yes.

In the actual working out of our business there, since Secretary Wilson has such a multitude of duties, I maintain very close contact in my office with the Assistant Secretaries of the Army, Navy, and Air Force, for materiel.

Senator MALONE. Who are they?

Mr. PIKE. They are Assistant Secretary Lewis of the Air Force.

Senator MALONE. Is Mr. Lewis here this morning?

Mr. PIKE. No. Unfortunately he could not be here. I have Colonel Carter from the Air Force.

The other Assistant Secretaries, Mr. Chairman, are Frank Higgins, Assistant Secretary of the Army, and in the Navy the Assistant Secretary of Materiel is Mr. Ray Fogler.

Senator MALONE. That is the Navy?

Mr. PIKE. Yes.

Senator MALONE. They have not created any more armor departments, have they?

Mr. PIKE. No. That is right.

The Marines, of course, came under the cognizance of the Secretary of the Navy.

Senator MALONE. Where does the artillery come in?

Mr. PIKE. That is part of the Army.

Senator MALONE. And the Marines are Navy?

Mr. PIKE. That is correct.

Senator MALONE. But they have not created a separate department for the Marines, the artillery——

Mr. PIKE. Each one of them serves their own organization. The Army has their own technical services such as engineers, et cetera. And the Navy is divided up into approximately seven bureaus.

Again, in an attempt to be as responsive to your questions—I think I see what you are driving at and what you are trying to bring out—I would like to emphasize that my office is only the channel through which the requirements information that we get from each one of the services is passed on to Dr. Flemming. We have the responsibility for checking it and being as reasonably certain as we are able to be that the requirements are neither overstated, nor understated.

Senator MALONE. Let me see now.

You are Assistant Secretary, directly under Mr. Wilson, with no one intervening, to advise him after you have consulted with the three services, and then drawn your own conclusions; you advise him how much of these critical materials and end items we need. Which means in the case of rutile and ilmenite and some other ores, if you went down that far. Maybe you would advise how to get those items.

But you also advise the Secretary how much of the end item of titanium you need.

Mr. PIKE. Titanium is not an end item. By "end item" we mean a tank or plane. They are made up of components, and then broken down into items of material.

Senator MALONE. Then you advise how many planes of different types, in your opinion, each one of these services needs and the total amount, and then advise the total amount of each critical material that enters into this end item that they need?

Mr. PIKE. We do not directly advise the Secretary of Defense; no. We receive these figures from the service.

In the case of titanium, the Air Force is the primary consumer. Our office is guided by the Air Force's statements of their own requirements.

Senator MALONE. Who checks them? Does anybody check them?

Mr. PIKE. No. They have their own leadership, starting with the Secretary of the Air Force. Harold Talbott is the top operating manager of the Air Force. And his materiel responsibility is delegated to Roger Lewis, who is Assistant Secretary of the Air Force.

Senator MALONE. Do you finally confer with Secretary Talbott, or only with Mr. Lewis?

Mr. PIKE. No. I have few dealings with Mr. Talbott. My contract—requirement contracts—are with Roger Lewis.

Senator MALONE. In the Army it is Secretary Stevens, is it not?

Mr. PIKE. The Secretary of the Army is Mr. Stevens.

Senator MALONE. And the Navy is Secretary Thomas?

Mr. PIKE. Charles Thomas; yes.

Senator MALONE. But you do not go beyond Messrs. Higgins, Lewis, and Fogler?

Mr. PIKE. That is correct.

Senator MALONE. They determine what all this amounts to, and they pass it to you, and you do not question it but go right ahead and pass it on to the Secretary?

Mr. PIKE. We review it.

Senator MALONE. How do you review it?

Mr. PIKE. We have a staff organization that has been set up just within the last year to do a job of review and analysis of the military requirements.

Very broadly speaking, to get away from the one metal or material we are talking about, the thinking of the organization was that heretofore there has never been any civilian check on the stated military requirements. We feel that this has been responsible in many situations for overbuying. We have, in our military system today, of course, substantial surpluses of end items as a result of World War II and the Korean war which presents us with a very substantial disposal problem; all of which is the general responsibility of our office.

So we have the Office of Requirements Review and Analysis. Carl Rolle, who is present here this morning, is the staff director for the materials phase of that Office.

Senator MALONE. In your office?

Mr. PIKE. That is correct; yes.

Senator MALONE. And he is the staff director?

Mr. PIKE. That is correct. He is Chief of the Materiels Branch in our Office of Requirements Review and Analysis.

Senator MALONE. And who is the staff director?

Mr. PIKE. Frank Brown.

Senator MALONE. Is he here?

Mr. PIKE. No.

Senator MALONE. Would you just explain, for the benefit of the committee, how you go about this? Suppose they say to you they want a thousand different things, do they break it down for you as to critical materials needed for each thing ordered?

Mr. PIKE. I think perhaps Mr. Rolle could give you a better detailed story on that than I could myself, Mr. Chairman.

Would it be satisfactory for Mr. Rolle to answer that question?

STATEMENT OF CARL ROLLE, STAFF DIRECTOR, MATERIEL, OFFICE OF REQUIREMENTS REVIEW AND ANALYSIS

Mr. ROLLE. Mr. Chairman, the information we get from the services consist not only of the total amount of the given material that they need over a given time period, but we also call for and get from them the so-called unit weights, that is, how much of this material goes into each B–52, into each F–100 fighter, into each of any other type of fighter airplane, or engine, or tank, or whatever it is; and the schedule of production of those items, which they took as the basis for coming up with the gross requirement.

We can then, of course, check the end-item schedule against the approved production schedules either for current use or for full mobilization, and by a certain amount of spotchecking we could uncover any actual arithmetic errors involved.

We question, whenever we feel the need to, the amount of the given material they say is to go into a particular item, find out where it is and do some checking on that.

So that when we get finished—and in some instances it results in—we do not revise their figures, but if we come across anything that is inconsistent, we succeed in having them revise their own figures and bring them into line.

That is the general process. Of course, it varies in minute details from item to item and from material to material.

Senator MALONE. Then, when you are finished, you, of course, report to your superior, Mr. Pike?

Mr. ROLLE. That is right.

Senator MALONE. You do not go beyond that. Mr. Pike gets his information from Messrs. Lewis, Higgins, and Fogler; from the Air, Army, and Navy.

This, of course, includes all the material ordered for the Army, Navy, and Air Corps?

Mr. ROLLE. That is correct.

Senator MALONE. Every item?

Mr. ROLLE. Every item that is involved in the particular material we may be talking about.

Senator MALONE. Take manganese, for example. Anything that is made of steel contains manganese. When you get through, do you know the amount of manganese that is going to be required to fulfill that year's or month's production?

Mr. ROLLE. In the case you have chosen, manganese, which, as you well know, is so broadly used in everything that uses steel, we do not

attempt to find out how much manganese is in an airplane or a gun or a tank. That is derived from the steel requirements. We do get the information as to steel requirements, and then there is a pretty consistent relationship, as you know.

Senator MALONE. You get the amounts of the different qualities of steel?

Mr. ROLLE. Right.

Senator MALONE. Then, of course, you have your table of metals?

Mr. ROLLE. That is right.

Senator MALONE. So that you have all the information to determine that?

Mr. ROLLE. That is right. In turn, the Office of Defense Mobilization, from the information we furnish them and from other sources, such as the Commerce Department, will then endeavor to build up a total national requirement, including military and all other uses.

Senator MALONE. You do not do that?

Mr. ROLLE. No, sir. We do not have any overall responsibility for the adequacy of supply. We furnish the military information.

Mr. PIKE. We do have responsibility of getting that type of information on military products and supplying the Office of Defense Mobilization. They have total responsibility.

Senator MALONE. But you could give it to us?

Mr. PIKE. Surely.

Mr. ROLLE. We could give you their studies. That is, we participate with them.

Senator MALONE. Give us your studies?

Mr. ROLLE. Of the military requirements; yes, we can do that.

Senator MALONE. Will you do that?

Mr. PIKE. Surely.

Senator MALONE. You see, we have so many other departments, and we have been in all of them. Maybe you do not go beyond your department, but somebody had better start pretty soon, because you have General Services Administration, as well as the Office of Defense Mobilization. Then we found the Department of Commerce across that trail. We find often a dozen or more organizations in the picture some place that can be a limiting factor.

Mr. PIKE. I think the way that generally works, Mr. Chairman, is that the Department of Defense has charge of the responsibility of getting the military requirements of the metal or steel.

Senator MALONE. Then let us go right to the heart of it. Who is responsible for not giving Mr. Flemming the military requirements?

Mr. PIKE. Speaking of titanium, and thinking of the Air Force as the primary potential large user, I wonder if I could read a bit of prepared statement I have here that I think will strike pretty close to some of your questions, and maybe we can go on from there.

Senator MALONE. Who is responsible? Tell me that first and then read it.

Mr. PIKE. Primarily the Air Force is responsible for their own.

Senator MALONE. They tell you, and you do not question it?

Mr. PIKE. We question it if the requirements appear to be greatly over or understated.

Senator MALONE. Let us go right back to who ought to tell you.

If someone told you that 150,000 tons of titanium was needed and was available, what would you do?

Mr. PIKE. If we were completely satisfied that the Air Force and aircraft industry, who have the primary relationship on this whole matter of how much titanium is needed, and when they gave us requirements that indicated that 150,000 tons a year was needed to build the best Air Force, we would be bound to pass that information over to the Office of Defense Mobilization.

However, the limiting factor is that we have not got requirements of that magnitude from the Air Force.

I think perhaps if you would let me read from this statement—I am attempting to be responsive.

Senator MALONE. As long as we are so close to it now: Yesterday when Mr. Garrett was here, he testified that perhaps one reason that no more was ordered than the 35,000 is because you are having trouble with fabrication and alloys as with any new metal and you want to whip those problems before you order it.

But if you wait for that, after it is ordered through the Office of Defense Mobilization and give them the go-ahead signal for any additional contracts, it takes time to write the specifications and then it takes 2 years to build a plane. So what you are doing is piling 2 or 3 or 4 years on the plane.

I think it is time we coordinated the paper talk with what we are doing.

Mr. PIKE. Mr. Chairman, let me say just this.

In answer to what I think you are driving at, the answer to this question is a matter between the Air Force and the aircraft industry and the titanium industry.

Senator MALONE. You know what the industry testified to, do you not?

Mr. PIKE. Yes. And I understand that that is a long-term statement, based upon the ironing out of some of the technical difficulties.

Senator MALONE. It is a long-term statement, all right, but they could use it if they had the specifications, and you figure maybe it would take a year or 2 years to iron out the specifications; but you want to wait that long before you let any contracts. I think you are going about it in the wrong way.

Go ahead, read or talk informally, whatever you wish.

TITANIUM REQUIREMENT

Mr. PIKE. I would like to submit this for the record.

In testimony before your subcommittee on November 27, 1954, my staff gave the latest available Department of Defense requirements for titanium, assuming no all-out mobilization, as 28,400 tons of sponge equivalent for the year 1956. This was a conversion from computed requirements of 17,000 tons of titanium mill products and assumed a 60-percent yield from sponge to mill products.

At that time you had received testimony from industry representatives which indicated much higher potential military needs. We stated we would institute a restudy of future military requirements in an effort to resolve the wide discrepancy between official and unofficial information. This study was completed some months ago, and the results reported to the Office of Defense Mobilization.

In view of improved practices in the utilization of scrap in producing mill products, the amount of sponge needed per ton of products is less than previously, and should continue downward. Hence, we now state requirements only in terms of mill products, which is the form in which titanium is purchased by military contractors. We leave it to the Office of Defense Mobilization to convert to sponge.

The revised requirements were requested on the basis that the supply would be available and that quality and fabricating problems would be solved. And I would like to reemphasize that.

When we call for a new statement of requirements from the Air Force we call for it on the assumption, told them to assume that supply would be available, and that quality in fabricating problems would be solved; just as you have indicated a few minutes ago.

So we were not putting any restrictions on the Air Force, as far as some of these problems are concerned. We were anxious to see the fullest, biggest picture that the Air Force would provide for us.

Senator MALONE. Do you have the estimate?

Mr. PIKE. Yes; we have the estimate. That material is secret. I have it here for your information, Mr. Chairman.

These requirements now cover the period 1954–58, assuming no mobilization. These data are classified, but are available for transmittal to you if you desire.

The new 1956 figure is much smaller than the previous 1956 estimate of 17,000 product tons. Even the 1958 figure is smaller than the previous estimate for 1956. This is in spite of the fact we carefully placed no limitations upon the services or their contractors except that the intended uses must be such that the military advantages would warrant the use of titanium rather than a cheaper alternate material.

Not only are these requirements farther than ever from the indications you gained from industry testimony last year, but actual placement of orders by industry is even less than these revised requirements. It must be understood that our requirements are not estimated solely by the Air Force and other services, but stem from data furnished by the very same companies whose representatives testified before your subcommittee last year.

We have reference there, of course, to the aircraft and engine manufacturers.

We can only presume that the estimates furnished you by the industry either were based on assumed aircraft production rates far higher than those presently authorized, or were based on the assumption that titanium could be used regardless of cost in places where it could confer no military advantages to justify the cost. I believe that a detailed scrutiny of the record of this industry testimony will disclose certain qualifications and assumptions that may well account for what appears on the surface to be a gross disparity that you pointed out earlier here.

We have also asked the services to develop titanium requirements for full mobilization, because under such conditions requirements obviously would reach a far higher level and present planning must take these into consideration.

These mobilization requirements are, of course, classified, and although they can be made available to you, it is sufficient to say at this point that they start at a higher level than the presently expected peacetime peak and proceed rapidly upward.

These mobilization requirements have been transmitted to the Office of Defense Mobilization, where they have been combined with nonmilitary requirement estimates.

Senator MALONE. Let me ask you at that point—and I think you have now given me some information upon which we can proceed—why do you proceed on a long-range, nonmobilization forecast and wait until somebody hits you with a bomb to do the other thing?

If you believe what you say yourself, why do you not get at it?

Mr. PIKE. I think our problem is that we have some big figures, a figure of 150,000 tons, that have been given by representatives of industry; whereas the figures that we have here are carefully computed bills of material, based upon current production schedules and anticipated production schedules for the next several years ahead.

These bills of material involving titanium are worked out and arrived at between the contracting officer of the Air Force and other contracting officers of the services, and the aircraft manufacturers. A great deal of what the Air Force contracting officer does depends a lot upon what the manufacturer's representative tells him he can buy and use in titanium.

I think we might be able to pin down a great deal of this disparity if we brought together the men at the working level from some of these aircraft companies, whose presidents or chief officers have made these statements, that we find a much more realistic type of picture. I think we would find that those large tonnages of eventual requirements, assuming all the technological problems were worked out, probably would be brought closer to the type of requirement figures that the Air Force is developing here.

Senator MALONE. I would say this to you, Mr. Secretary, we have had much testimony here from industries that want titanium. The reason why I have Mr. Cullen here this morning is to find out why it is rationed; why it is not available in civilian industries as it is to you, if you do not really need it.

Mr. PIKE. That was one phase of the problem I am not familiar with.

Senator MALONE. If we determine you do not really need it, we are going to break this open and start doing something else. But if we determine you need it and have to have it to make these planes, we are about to decide that you are assuming there will be no war.

Mr. PIKE. I do not think any of us will assume there is not going to be any war.

To finish up my statement:

These mobilization requirements have been transmitted to the Office of Defense Mobilization, where they have been combined with nonmilitary requirement estimates. The Office of Defense Mobilization has developed a program for the further expansion of the titanium industry and the stockpiling of titanium sponge, which is aimed at meeting these requirements.

In view of the fact that such a program will involve possible Government obligations of some $2 billion, Dr. Flemming has just recently asked us to take a final hard look at our requirements. This we are now in the process of doing. You will recall we discussed this in our telephone conversation the day before yesterday.

This program, because of its magnitude, will necessarily be carefully considered before it is authorized, a process I am sure you will agree

with, hence I could not say at this time just what steps will be undertaken in the way of expansion and stockpiling.

In closing, I would like to say that while we have instructed the services and, through them, their contractors, to ignore present problems of quality, uniformity, and fabricating techniques in arriving at future requirements for titanium, these problems do continue to exist and have the effect of delaying the adoption of new uses for titanium. For this reason it is doubtful if the forecast 1954–58 requirements will materialize on schedule and there is possible doubt as to whether the full mobilization requirements would materialize unless these problems are solved soon.

Now, I was very hopeful that I could get Roger Lewis to come down here today. I talked to him after I talked to you, and, unfortunately, he has to be out of town today. I asked him to give me somebody from his office in the Air Force that was in a position to know some of the answers to questions which I had pretty well in mind as a result of our conversation.

I have Colonel Carter here, who has been designated by Secretary Roger Lewis, and perhaps he could give you, being in the operational end of this business, a little more responsive answer to some of the very important questions you have raised here.

Senator MALONE. Do you want to proceed, Colonel Carter?

First, would you please identify yourself for the record?

STATEMENT OF COL. WILBUR R. CARTER, DEPUTY DIRECTOR OF INDUSTRIAL RESOURCES, HEADQUARTERS, USAF

Colonel CARTER. I am Col. Wilbur R. Carter, Deputy Director of Industrial Resources, Headquarters, USAF.

Pertinent to the question that you had asked earlier, Senator, you asked if I worked for Secretary Lewis: Secretary Lewis has the responsibility for the materiel programs and is responsible to Secretary Talbott. I am in the military channel responsible to the Deputy Chief of Materiel, General Boatner, whose programs, in turn, come under the cognizance of Secretary Lewis.

Rather than making an opening statement, or any statement, sir, I think it might be better if I attempt to answer any questions that you might have.

NONMOBILIZATION AND MOBILIZATION STUDIES

Senator MALONE. I might start with the one I just asked the Secretary. I notice that you have a long range nonmobilization forecast in 1953, and then again in 1954 you have a mobilization study. I would ask you, first, what is the difference? Can you define mobilization and nonmobilization studies? What do you mean by that?

Colonel CARTER. Senator, I think I will probably reiterate several things that have been told you many times before.

Senator MALONE. Very well.

Colonel CARTER. The nonmobilization program is the current buying program that we have. The mobilization program reflects requirements under mobilized conditions, as I am sure you are aware of.

Senator MALONE. What is your time element on a nonmobilization basis? Are we getting ready for a war?

Colonel CARTER. I would say this, Senator, that at all times it is the responsibility of the military to be in the best possible position to undertake a war in the event mobilization comes along at any time. You cannot choose the time when it will come, sir.

Senator MALONE. How do you do that?

Colonel CARTER. That has been carried on by the Air Force.

I think one of the most tangible and recognizable moves is to get the Air Force up to the position where the required materiel is available.

Senator MALONE. I agree with you when you talk about having the materials available. You have tungsten and manganese and many of these other materials. So it is a matter of when you use them. But when you come to a material that you do not have and it restricts you, what do you do?

Colonel CARTER. We were faced with a comparable problem which you may or may not be familiar with. That is in the case of cobalt. We designed away from it where we possibly could. We increased the economic utilization of the cobalt that we had available.

Senator MALONE. How do you design into titanium if you want long-range planes of sonic speed?

Colonel CARTER. I was referring to cobalt.

Senator MALONE. I know you were. But I would like you to comment on that question.

Colonel CARTER. I will say this—and this is a reiteration of a statement that Major General Metzger has made some time in the past to you—that certainly better performance characteristics can be obtained from aircraft with beneficial application of titanium.

Senator MALONE. Let me ask you another question. Our time is limited and there is no need in explaining to me something about which I am familiar.

Can you make a sonic speed plane that can go 10,000 miles, fly to the destination and fly back, without refueling, without titanium?

Colonel CARTER. Do you mean above the speed of sound? I doubt that it can be done.

Senator MALONE. Do you not think we have to have them?

Colonel CARTER. I do.

Let me qualify that.

Senator MALONE. I do not want you to qualify that; I want you to answer it.

Colonel CARTER. I will answer it. You can not take a dependable material and put it in a critical product, sir.

Senator MALONE. You have a material here almost like uranium in the nuclear field. If the other fellow has it and you do not, I might ask what happens to you?

Colonel CARTER. As you stated before, you have the second best poker hand.

Senator MALONE. Almost everyone I have talked to assumes it is going to take a little time, that time will solve the problem of alloys and of fabrication. It may take a year, it may take a year and a half, maybe 2 years; it is hard to tell.

But do you agree with that statement?

Colonel CARTER. It will take a period of time to solve the technical problems; yes, sir.

Senator MALONE. Do you think they will be solved?

Colonel CARTER. Yes, sir; I think they will be.

UTILIZATION OF TITANIUM

Senator MALONE. Do you think you should wait until the problems are solved to place your orders for the raw materials for the fabrication, knowing it will require a couple of years beyond that date to let the contracts and build the plants to produce additional titanium?

Colonel CARTER. Senator, I am not ducking your question, but I think this is quite pertinent to it, sir: that the potential utilization of titanium must come from the aeronautical industry, the man who is manufacturing the product we are getting right now, and he is the man who must be satisfied that these technical problems are in hand or will be in hand at the time that he needs the material.

We are operating on information that comes from the aeronautical manufacturers.

Senator MALONE. Here is what Mr. Gross says:

> We cannot design for titanium unless it is available in the quantities required * * *

That is why we took the trip of 3,000 miles to find out what he would say. He said the same thing the other day and also said many other things that you should know.

To continue his statement:

> The total production of titanium for 1953, we understand, has been estimated at 3,300 tons of sponge. By 1956, we understand, this will grow to approximately 22,000 tons of titanium sponge. Using a factor of 60 percent for the conversion of sponge into metal, we will have approximately 4 million pounds of titanium in 1955 and 26 million pounds in 1956 * * *

And, of course, suppose you would agree with some of the technicians that they will whip that percentage one of these days.

These are not my estimates. I am just trying in my way to get the material together so we can use the best judgment we have.

Mr. Gross says:

> Now, against this, we assume, must be balanced the industrial requirements.

Suppose he could say that in 1956 there is going to be 150,000 tons of this material; what do you suppose he would tell you when you write to him and ask him how much you can use?

Colonel CARTER. It would be conjecture on my part, sir.

Senator MALONE. Why do you not write him a letter? If you want to get that information, I would advise you to do it. Or you might call on General Metzger; you seem to have considerable confidence in him. At least I do.

Have you asked General Metzger anything about it?

Colonel CARTER. I talked to General Metzger quite a few times about it. In fact, when I was out in the field some 3 years ago, I started the work for him in titanium.

Senator MALONE. What do you think of this statement of Mr. Gross?

Colonel CARTER. I think this is quite pertinent, Senator, and the point that I tried to make before is that we asked the contractor, we asked Mr. Gross, along with other aeronautical manufacturers, as to

what he was going to require, titaniumwise. And the figures given this morning are multiplications of those figures against the number of aircraft we are going to buy of the type Mr. Gross or other manufacturers build.

For the mobilization requirements, we followed the same procedure, sir.

Senator MALONE. In other words, we are back where we started with Mr. Garrett. We know that titanium is not available, and so does Mr. Gross. So you order planes based on what you know is going to be available, and he orders based on what you have ordered from him.

Colonel CARTER. The statement that went out to the manufacturers, sir, asked:

Assuming that there would be adequate availability and that the technical problems will be solved, how much titanium is going to be used in your product that you build?

Those are the figures that came back from the aeronautical manufacturers.

Senator MALONE. Have you ever asked them to design a plane with the amount of titanium in it that they think ought to be in it?

Colonel CARTER. Senator, I do not wish to seem unresponsive to your question, believe me; but I think the proposition was put to the manufacturer the other way around. We stated the performance characteristics we wanted.

Senator MALONE. What performance did you want? Certainly there is range, speed, payload, et cetera, that should be gone into.

You do not have the amount of titanium you need to make the needed number of fighters of maximum speed and range, do you?

Colonel CARTER. I will not answer the question, "Yes," or "No," sir, because I think there are other factors that influence it.

Senator MALONE. Just tell me, do you have the titanium?

Colonel CARTER. The titanium, yes, sir; it is obviously adequate right now.

Senator MALONE. To make all the fighters that you want?

Colonel CARTER. I did not say that.

Senator MALONE. That is what I asked you. "Yes" or "No"; do you?

Colonel CARTER. Do we have the titanium for all the fighters that we——

Senator MALONE. That you would like to have, that are necessary for the program, of a maximum speed and maximum range, that you would order if you had the titanium.

Colonel CARTER. I do not believe I can answer that question, sir.

Senator MALONE. Of course, you can. Do you have it for the bombers you need? I suppose you know you need them. Can you not answer that, either?

All right, Mr. Pike, I would like to again come back to the question. If you had the titanium available today, how much of it would you need for bombers, fighters, and so forth?

Mr. PIKE. I think that the whole limiting factor is the factor you recognize and we all recognize, that although we have asked for requirements of the Air Force and the Air Force has justified that they have asked the Boeings, the Lockheeds, and the Douglas Aircraft companies to tell them what their requirements will be——

Senator MALONE. For what?

Mr. PIKE. For titanium; assuming that all of the production problems, in other words, the available quantity, the difficulties in manufacturing and fabricating the material were eliminated.

We have put all of those things into our requests for these requirements. And the answers ultimately come from the aircraft manufacturers through the Air Force to us, through Flemming. Those are the figures we got you there, and I think those figures are still smaller than the ultimate large figures.

Senator MALONE. I think I have it, if I could ask you one other question. Was this based on the orders you have already given them?

Mr. PIKE. Some of those schedules there are based on——

Senator MALONE. I do not know whether I made this clear or not. When I asked this question about how much do you need to make these planes if you had the titanium available, does that mean they assumed, when you answered the question, to make the planes for which there were orders on the board?

Mr. PIKE. On the schedules there, covering so-called peacetime operating requirements, I would guess that perhaps part of the figures were on orders currently in hand and part were figures based on estimates of follow-on orders.

On the mobilization requirements, of course, there are tremendously increased quantities of aircraft of all kinds.

Senator MALONE. In other words, they would get more orders, therefore, they would need more titanium?

Mr. PIKE. I think that is generally correct, sir.

I think that answers the question. They have the orders for the planes and they do not anticipate they are going to get any more. Therefore, they have told you how much titanium they need to make the planes you have already ordered.

Mr. PIKE. Colonel, do you know, on the figures that we have for 1954–58 requirements; does that represent delivery schedules on present contracts in the hands of the aircraft industry, or is that a combination of contracts plus estimated follow-on orders?

Colonel CARTER. The contractor takes it by type of aircraft. He says he will need this much titanium now and will make additional applications later on for this much.

Senator MALONE. There is no problem about it. You order a certain number of planes and they ask you how much titanium is needed for the planes ordered. There is no mystery about it.

Will you come up here, Mr. Cullen?

STATEMENT OF HERBERT L. CULLEN, ANALYST, MISCELLANEOUS METALS AND MINERALS DIVISION, BUSINESS AND DEFENSE SERVICE ADMINISTRATION, DEPARTMENT OF COMMERCE

Senator MALONE. Mr. Cullen, will you first identify yourself for the record and then tell us what your job is, to whom you report, and what you are supposed to do? Do you cover more than one material, and, specifically, the material we are talking about this morning?

Mr. CULLEN. Yes, sir; Mr. Chairman.

My name is Herbert L. Cullen. I am analyst in the Miscellaneous Metals and Minerals Division of the Business and Defense Service Administration, Department of Commerce.

Senator MALONE. What range does that cover, how many metals and minerals?

Mr. CULLEN. We have approximately 125 different metals and minerals in our division.

Senator MALONE. Do you have a list of them?

Mr. CULLEN. Not with me; no, sir.

Senator MALONE. Would you submit it for the record so we will have it at this point in the transcript?

Mr. CULLEN. Yes, sir.

(The material referred to is as follows:)

COMMODITIES—MISCELLANEOUS METALS AND MINERALS DIVISION

Amblygonite
Andalusite
Antimony
Asbestos fiber
Asbestos products
Ball clay
Barite
Bastnasite
Bentonite
Beryl
Beryllium
Biotite
Bismuth
Block talc (lava grade)
Brookite
Cadmium
Calcite (optical)
Carbon and graphite products
Carbon electrodes
Celestite
Corundum
Cryolite (natural and synthetic)
Diamonds, industrial
Diatomaceous earth
Diatomite
Dumortierite
Emery
Feldspar
Fibrous glass
Fire clay
Flint
Fluorspar
French chalk
Fuller's earth
Garnet
Germanium
Gold
Graphite (natural and artificial)
Graphite crucibles
Graphite electrodes and anodes
Grinding pebbles
Ilmenite
Indium
Kaolin (china clay)
Kyanite (mullite)
Lead
Lepidolite
Magnesite
Meerschaum
Mercury
Mica
Mineral wool
Miscellaneous specialties
Monazite
Muscovite
Osmiridium
Osmium
Packing and sealing rings
Palladium
Petalite
Phlogopite
Platinum
Prophyllite
Pumice and pumicite
Quartz (radio grade)
Rare earths
Rhodium
Ruthenium
Rutile
Selenium
Sillimenite
Silver
Soapstone
Spodumene
Steatite
Talc
Tantalum
Tellurium
Tin
Titanium
Topaz
Tripoli
Vermiculite
Witherite
Zinc
Zinnwaldite
Zirconium

Mr. CULLEN. I am supposed to be handling, in addition to titanium, materials such as zirconium, fluorspar, cryolite, to mention some of the more important ones.

Titanium takes about 100 percent of my time, so I do not get the chance right now to devote much attention to the others.

Our responsibility on metals and minerals is chiefly from a distribution angle, but we do have responsibility in mobilization planning.

Senator MALONE. Are you talking about mobilization for defense?

Mr. CULLEN. Yes, sir.

Senator MALONE. Do you know any of these men? Do you have any connection with national defense?

Mr. CULLEN. Yes, sir; we work with them all the time.

Senator MALONE. Where do you come in? Are you over them? If you say they can have the material, can they have it? Is that the way it is?

RESPONSIBILITY OF BDSA RE TITANIUM

Mr. CULLEN. Well, the Business and Defense Services Administration is the successor agency to the National Production Authority. We have the allocation authority that the National Production Authority had. We can allocate. We are not now allocating any materials. We do have 1 or 2 of the orders still in effect. One is Order M–107, on titanium.

Senator MALONE. Do you have a copy of that order?

Mr. CULLEN. I will be glad to get you a copy.

Senator MALONE. Could you put it into the record?

Mr. CULLEN. All right, sir.

(The material referred to is as follows:)

M–107
May 19, 1954

U. S. DEPARTMENT OF COMMERCE

BUSINESS AND DEFENSE SERVICES ADMINISTRATION

TITLE 32A—NATIONAL DEFENSE, APPENDIX

CHAPTER VI—BUSINESS AND DEFENSE SERVICES ADMINISTRATION, DEPARTMENT OF COMMERCE

[BDSA Order M–107 of May 19, 1954]

M–107—TITANIUM MILL PRODUCTS

This order is found necessary and appropriate to promote the national defense and is issued pursuant to the Defense Production Act of 1950, as amended. In the formulation of this order there has been consultation with industry representatives, including trade association representatives, and consideration has been given to their recommendations.

Sec.

1. What this order does.
2. Definitions.
3. Applicability of BDSA Reg. 2.
4. Limitations on required acceptance of rated orders.
5. Scheduling of deliveries pursuant to rated orders.
6. Requests for adjustment or exception.
7. Records and reports.
8. Communications.
9. False statements.
10. Violations.

AUTHORITY: Sections 1 to 10 issued under sec. 704, 64 Stat. 816, Pub. Law 95, 83d Cong.; 50 U. S. C. App. Sup. 2154. Interpret or apply sec. 101, 64 Stat. 799, Pub. Law 95, 83d Cong.; 50 U. S. C. App. Sup. 2071; E. O. 10480, Aug. 14, 1953, 18 F. R. 4939.

SECTION 1. *What this order does.* This order limits the obligation of producers of titanium mill products to accept rated orders for such products. The order also provides for the scheduling of deliveries of titanium mill products pursuant to rated orders.

SEC. 2. *Definitions.* As used in this order:

(a) "Person" means any individual, corporation, partnership, association, or any other organized group of persons, and includes any agency of the United States Government or of any other government.

(b) "BDSA" means the Business and Defense Services Administration of the United States Department of Commerce.

(c) "APRA" means the Aircraft Production Resources Agency of the Department of Defense.

(d) "Titanium mill products" means commercially pure titanium or titanium alloy in the following forms: Ingot, billet, sheet, strip, plate, rod, bar, wire, tubing, extruded shapes, and rolled structural shapes.

(e) "Commercially pure titanium" means unalloyed titanium made by commercial production methods, with a titanium content of 99 percent or more by weight and containing fractional percentages of such elements as carbon, nitrogen, oxygen, or iron.

(f) "Titanium alloy" means a ductile titanium-base alloy containing 50 percent or more titanium by weight and lesser percentages of other metals and/or interstitial elements.

(g) "Producer" means any person who produces commercially pure titanium or titanium alloy by melting titanium sponge and/or titanium scrap; any such person's "production of titanium mill products" means the production by him, or by other persons for his account, of titanium until products in the form in which they are to be physically delivered to purchasers pursuant to orders accepted by him. A person who produces titanium mill products from other titanium mill products but who does not produce commercially pure titanium or titanium alloy by melting titanium sponge and/or titanium scrap is not deemed a "producer" for the purposes of this order.

SEC. 3. *Applicability of BDSA Reg. 2.* The provisions of BDSA Reg. 2 (formerly NPA Reg 2) are superseded to the extent that they are inconsistent with the provisions of this order. In all other respects the provisions of BDSA Reg. 2 shall remain in full force and effect.

SEC. 4. *Limitations on required acceptance of rated orders.* Unless specifically directed by BDSA, no producer of titanium mill products shall be required to accept rated orders calling for delivery during any calendar month, commencing with the month of June 1954, of an aggregate quantity of titanium mill products by weight which exceeds 90 percent of his scheduled production of such products for that calendar month: *Provided, however,* That no producer shall cancel or postpone delivery of any rated orders already accepted because such orders exceed 90 percent of his scheduled production for that month.

SEC. 5. *Scheduling of deliveries pursuant to rated orders.* (a) Not later than the fifteenth day of any calendar month, commencing with the month of June 1954, each producer of titanium mill products shall furnish in writing to APRA, care of Air Materiel Command, Wright-Patterson Air Force Base, Dayton, Ohio, a detailed schedule of his projected production of titanium mill products pursuant to rated orders for delivery during that month and each of the next two succeeding months. Such schedules shall show substantially the following information with respect to each accepted rated order calling for delivery of titanium mill products during the 3-month period covered by the schedule, together with such further information as BDSA may from time to time to require: customer's name and address, customer's purchase order date and number, the mill order number, the defense contract number, the DO rating, the form or shape, the alloy or grade, sizes, estimated total weight in pounds, pounds shipped against such order in the preceding month and in prior months, and pounds scheduled for shipment during each of the months covered by this schedule.

(b) APRA will transmit each producer's schedule to the Department of Defense, Washington 25, D. C., together with APRA's recommendations thereon. The Department of Defense will transmit each producer's schedule to BDSA, together with its recommendations thereon, not later than 7 days prior to the end of the first month shown on such schedule. BDSA will review such schedules, together with the Department of Defense recommendations thereon, and will issue to each producer not later than 3 days prior to the end of the first month shown on such schedule a directive covering his production of titanium mill products to fill rated orders during the two succeeding months.

SEC. 6. *Requests for adjustment or exception.* Any person subject to any provision of this order may file a request for adjustment or exception upon the ground that such provision works an undue or exceptional hardship upon

him not suffered generally by others in the same trade or industry, or that its enforcement against him would not be in the interest of the national defense or in the public interest. The filing of a request for adjustment or exception shall not relieve any person of his obligation to comply with any such provision. In examining requests for adjustment or exception claiming that the public interest is prejudiced by the application of any provision of this order, consideration will be given to the requirements of public health and safety, civilian defense, and dislocation of labor and resulting unemployment that would impair the defense program. Each request shall be in writing, by letter in triplicate, shall set forth all pertinent facts and the nature of the relief sought, and shall state the justification therefor.

SEC. 7. *Records and reports.* (a) Each person participating in any transaction covered by this order shall make, and preserve for at least 2 years thereafter, accurate and complete records of receipts and deliveries in sufficient detail to permit the determination, after audit, whether each transaction complies with the provisions of this order. This order does not specify any particular accounting method and does not require alteration of the system of records customarily used, provided such records supply an adequate basis for audit. Records may be retained in the form of microfilm or other photographic copies instead of the originals.

(b) Each producer shall, not later than the fifteenth day of each month (commencing with June 15, 1954), complete and file Form BDSAF–263 in accordance with instructions accompanying the form.

(c) Persons subject to this order shall make such records and submit such further reports to BDSA as it shall require, subject to the terms of the Federal Reports Act of 1942 (5 U. S. C. 139–139F).

SEC. 8. *Communications.* All communications concerning this order, except as otherwise specified in this order, shall be addressed to the Business and Defense Services Administration, Washington 25, D. C., Ref: BDSA Order M–107.

SEC. 9. *False statement.* The furnishing of false information or the concealment of any material fact in the course of operation under this order constitutes a violation of this order.

SEC. 10. *Violations.* Violation of any provision of this order may subject any person committing or participating in such violation to administrative action to require compliance with this order and correction of such violation. In addition to such administrative action, an injunction and order may be obtained prohibiting any such violation and enforcing compliance with the provisions hereof. Any person who wilfully violates any provisions of this order, or who wilfully furnishes false information or conceals any material fact in the course of operation under this order, is guilty of a crime and upon conviction may be punished by fine or imprisonment or both.

NOTE: All reporting and record-keeping requirements of this order have been approved by the Bureau of the Budget in accordance with the Federal Reports Act of 1942.

This order shall take effect May 19, 1954.

BUSINESS AND DEFENSE SERVICES ADMINISTRATION,
By GEORGE W. AUXIER, *Executive Secretary.*

Mr. CULLEN. The titanium order was issued back in February in order to assure the producers of titanium products that they could place civilian orders for titanium in their schedules and assure their customers of delivery. What we did was actually set aside 10 percent of their production for civilian orders.

Senator MALONE. Of whose production?

Mr. CULLEN. The manufacturers of titanium mill products, sheet and bar and tubing, etc.

Senator MALONE. Are you talking about the fabricators or the manufacturers of the metal?

Mr. CULLEN. The manufacturers of what we call the mill products, the people who take the sponge and convert it into usable form.

Senator MALONE. Then you say they can take 10 percent of the production and use it where they want to?

Mr. CULLEN. At least 10 percent.

If military orders are not forthcoming, under the order, they certainly do not have to restrict their production. They can accept any number of orders as long as they take all the military orders up to 90 percent of their schedules.

Senator MALONE. Then, it is 10 percent of the production that is not available to the military at the moment; is that correct?

Mr. CULLEN. That is right.

Senator MALONE. At least 10 percent?

Mr. CULLEN. At least 10 percent.

Senator MALONE. And if the military cannot use all that is available, that particular part would go for civilian use; is that correct?

Mr. CULLEN. That is correct.

Senator MALONE. None is being stockpiled?

Mr. CULLEN. Not in the mill product form; no, sir. We are buying the sponge. The Government, through General Services Administration, is buying the sponge through what we call a revolving fund at present, which is sponge that will be made available to the mill products producers when they need it.

Senator MALONE. I think maybe we are responsible for that. There was a rumor around Washington here, that titanium was running out of our ears and that we did not need it at all, did not want to produce any more. So we had a meeting up here one day and found out that the General Services Administration was ordered to stockpile it until we had enough.

Mr. CULLEN. The idea is to provide a surplus, Senator, and get material put aside so that the aircraft contractors and other people will eventually decide there is plenty of it available and design into it.

Senator MALONE. What is your general understanding as to whether or not the aircraft manufacturers or producers want more than they are getting so that they can design it into the plane?

Mr. CULLEN. I think people like Mr. Rolle here can tell you that they will not design into a new material or into any material unless there is a very substantial surplus ahead of them, and they can see there is plenty there in case we get into an emergency, so that they will not be caught with a model in production where the material is not available.

Senator MALONE. Mr. Cullen, I think you put your finger right on the whole problem. I know that has been the testimony of the manufacturers of the engines, of the planemakers, that they just cannot afford to do it. One enginemaker testified that he had a plan that they would test out—he has already done this, according to his testimony—for many parts of an engine. They do not just make a jet engine out of titanium and put 40 percent in it so that you can turn the wheels and you are out in a week or a month. But they take one part.

He was assured by the General Services Administration, or Dr. Flemming, or by the National Defense, that once you put that in, the material is there to keep making the number of engines you are making in the United States and keep that part in, we have had testimony here for 2 days, that maybe then they do not want it.

Mr. CULLEN. I think they do want it.

That, of course, is the reason why we are trying to build up sponge capacity. Right now we are trying to get into being a program to build up melting capacity, providing contractual assistance to the ingot makers and the producers of the mill products. They asked for this some time ago.

As soon as the mobilization requirements figures are firm, General Services Administration in conjunction with the Office of Defense Mobilization, will establish at this contractual assistance program and permit the mill products people to build up their capacity.

The next step, of course, is the processing facilities.

I think the people down the line in Government are doing all that they can, Senator, to keep this titanium situation rolling and get the material available as quickly as possible.

Senator MALONE. It seems to me what you say makes considerable sense.

Mr. CULLEN. The big problem is the disparity between current requirements and what the people think we are going to need. This year we will produce a total of about 1,200 tons of titanium mill products. That is in the mill products form. Our production of sponge will be around 5,100 tons.

Senator MALONE. Do you think it will amount to that much this year?

Mr. CULLEN. According to the information we have as of October.

Senator MALONE. You may be right, because the testimony we have received from the Henderson plant was that they had reached 10 tons per day and had met the specification. Do you agree with that?

Mr. CULLEN. Yes, sir. But with mill products production of only 1,200 tons a year, certainly the industry has to have more business before it can expand.

In my opinion, the only thing that is possible here is to work out some system whereby the aircraft contractors and the Air Forces can get together on gradual application of the material, use the plants now in production, and get the melting and rolling section of the industry built up in line with sponge.

Senator MALONE. You see, we are worrying about this because we do not believe adequate steps are being taken to prepare for an emergency. Russia seems to be preparing all the time.

If they were not ready, if there was no reason for us to get ready, we certainly would not be interested in titanium. It would go, of course, just like aluminum and magnesium and other materials.

But we always come back to the same thing. If we order a number of planes, or it might be freezers, or cement mixers, and then we ask the manufacturer how much steel he needs to make those cement mixers and he tells us, and we say that is all we need and therefore we are not going to raise the amount.

For 2 days I have been on that trail. What would you suggest?

Mr. CULLEN. It is a difficult problem.

Senator MALONE. For whom? Either we need it for defense or we do not need it. If we need it for defense we are responsible for ordering it, so that next year and the years thereafter, we are not confined to a 10-percent increase, or 15, but at least that we are attacking the problem.

Who is responsible for it? You?

Mr. CULLEN. No, I would say our responsibilities are simply to see that the facilities are there when they are needed.

Senator MALONE. You need it now. How are you responsible for that part of it?

Mr. CULLEN. We are responsible for building up the distribution end of the business from the sponge on.

Senator MALONE. I am talking about more sponge. But you do not touch it except from the sponge stage on; is that right?

Mr. CULLEN. That is right. The sponge is a General Services responsibility.

Senator MALONE. You have 150,000 tons of metal available, but you need considerably more sponge than that, and you must get it somewhere.

Mr. CULLEN. We can foresee that this is going to be quite an industry. We will be busy.

Senator MALONE. Do you have any information as to the demand in civilian industry, if it were available, so that it could be put into production with confidence?

Mr. CULLEN. The information is not too good, Senator. We worked through all of our industry divisions down there in our unit earlier this year, trying to get estimates of what would be used. The general opinion was that the material was too costly at this time for industry to be interested in it.

Senator MALONE. Who testified to that?

Mr. CULLEN. We worked through our industry divisions, and they contacted their industries. In other words, the Chemical Division contacted the chemical industry.

Senator MALONE. Did they cover the milk companies?

Mr. CULLEN. No. They have a good processing industry there.

Senator MALONE. We had 2 witnesses here, 1 from Monsanto Chemical and a milk company. Monsanto Chemical testified they wanted all they could get at the present price.

Mr. CULLEN. The mill products producers have not been able to get any orders.

Senator MALONE. They cannot get any. Is that it?

Mr. CULLEN. They cannot sell it.

Senator MALONE. Why is that? Why would they testify here they wanted it and then they could not buy it because there is not enough in the future to go into it?

Mr. CULLEN. We do not understand it, Senator.

Mr. PIKE. Senator, I have with me here Mr. Warren Webster, who is in my office and who is Director of Production and Procurement Policy. Mr. Webster and Mr. Turner, being men who are new in the industry, made a trip last spring and visited several aircraft and several engine manufacturers. They had two missions in mind. One was to take a look at the aluminum requirements, which we were doing, and the other was to take a look at this titanium thing, which is up for consideration now.

I think Mr. Webster might be able to make several comments on his observations on that trip that would be helpful to this record here.

Senator MALONE. Go ahead, Mr. Webster.

STATEMENT OF WARREN WEBSTER, DIRECTOR OF PRODUCTION AND PROCUREMENT POLICY (SUPPLY AND LOGISTICS), DEPARTMENT OF DEFENSE

Mr. WEBSTER. We were very much interested in the use of titanium, as you might well realize, and we wanted to find out just what the proposed applications of titanium might be on the part of the aircraft industry.

Senator MALONE. You are talking now outside of national defense, are you?

PROPOSED APPLICATIONS OF TITANIUM IN AIRCRAFT

Mr. WEBSTER. I am talking purely military. We visited North American, Lockheed, Douglas, Boeing, Republic, and possibly 1 or 2 others. And that included the aircraft engine manufacturers, Pratt-Whitney, and Wright.

We were very much amazed to find the small amount of planning that was tying into the use of titanium in their new models. We did not discuss this merely with the tops of the company, but we had the full group of all their engineers, their planning groups, their production people, and all of those who might have an interest in the use of titanium.

With the exception of 1 or 2 plants, they all said that they could use titanium in quantity, provided the quality improved and the price came down, but that with the current condition of titanium, the availability of titanium and the fact that they could not get the quantity of the right quality, that that means they could not take the chance in designing into their planes the use of titanium to the fullest extent.

Senator MALONE. You mentioned something that is very interesting to me.

In the first place, the commercial planes people testified that they would take it; that they wanted titanium at the present time. They wanted it much cheaper, of course, but they said they could use it and would use it at the present price.

It was also testified—and you probably understand it better than I, I only listened to this evidence—that one pound of titanium saves a lot of plane if it is known in the beginning that you are going to have it, following right through the engine.

Mr. WEBSTER. That is right.

Senator MALONE. Was it 7 or 8 pounds to 1?

Colonel CARTER. Ten was the figure in the testimony, sir.

Senator MALONE. I have heard so much information about it that I have difficulty remembering the exact figure.

Then to follow it on through, an engine made, say, of 25 to 40 percent of titanium, whatever it is, would need less wingspread, and so forth. They said if they could obtain it they could pay up to $80 a pound for it and it would be economically feasible.

So it does not make sense now to say, unless you have something to back it up, that they cannot use it unless they reduce the price. Everybody wants the price reduced, but that is not necessary. That is just like in the case of the chemical company, there are only a few chemicals needed and so it is very helpful.

So that, regardless of price, if you are talking about national defense, who decides what you use to manufacture a plane?

Mr. WEBSTER. That is entirely up to the contractor when he is bidding on specifications, or performance. He decides. Am I correct on that, Colonel? He decides whether there is more or less titanium to be used in the plane. That is decided by the contractor.

Senator MALONE. I think you are exactly right.

Then the specifications you give them are not the specifications of the maximum speed or performance that you need, because you do not think it is available. You just said, Colonel, a while ago, that you did not give them any orders for a sonic-speed plane that will go five to seven thousand miles and return without refueling, that you just have not given out those orders because you do not think they have the material to make them.

Mr. PIKE. Of course, there are items other than the term "titanium" involved in supersonic planes. There are technical problems before they want to go into production in quantity.

Senator MALONE. Of course. But you had better start taking these problems one at a time, and we are on one of them today.

Mr. WEBSTER. We did not tie in specific specifications, and it is not in our field. We merely asked them what we could do.

Senator MALONE. You are testifying now in a field that you are occupied in, that you did not take that into account.

Mr. WEBSTER. We took into account exactly what they had to deal with in the specifications they had.

Senator MALONE. But you did not take into account the specifications that you would get if they had the material.

Now, I am not interested in ordinary planes. Everybody knows how to make those, and you are making them. I want to spend more time helping you make a plane better than anybody else has, we hope. And you are not making it; are you?

Mr. WEBSTER. We think so right now.

Senator MALONE. You do?

Mr. WEBSTER. Yes.

Senator MALONE. Are you making one that will go past sonic speeds and will go 5,000 or 7,000 miles, a bomber that will return without refueling; if you are making more than one, or if you are making any?

Mr. PIKE. The principal factor there is the horsepower and thrust on the big engine of bombers, Senator.

Senator MALONE. Have you ordered them?

Mr. PIKE. No. They are in the research and development stage.

Senator MALONE. Then there is nothing ready to go, nothing to start on now, even if they knew this material was going to be available, that you could order beyond what you are ordering; do you believe that?

Mr. PIKE. No, I do not say that. I do not believe that. I think we have a very difficult problem here.

Senator MALONE. I do not think you are meeting it.

Mr. PIKE. It is a chicken-and-egg type of problem.

Senator MALONE. I have heard that a hundred times.

Mr. PIKE. I think you have a primary relationship here between the Air Force as the biggest potential user and the aircraft manufacturing industry.

Senator MALONE. I do not think they are the biggest potential users after you get what you want.

Mr. PIKE. I am speaking strictly from a military standpoint, sir.

Senator MALONE. From a military standpoint, naturally, that is true.

Mr. PIKE. Senator, if I could make the suggestion, if you could get the Assistant Secretary of the Air Force for Material, Roger Lewis, he is the man that is competent in the industry.

I knew Roger back in the early forties, when he was at Lockheed. I think up to 1950 he was with Curtiss-Wright. He has grown with this industry.

I think if you got him together with 1 of the leading engine manufacturers and 1 of the men that you have also heard testimony from, that you have a chance of really getting down to the brass tacks and the nub of this problem that I see you are trying to get to. We are not engaged directly in operations here. I have tried to explain our part in this picture to you.

Senator MALONE. I think you may be right. I thought we had completed the circle this morning, but I guess we did not.

You do not have anything to do with ordering the planes, do you?

Mr. PIKE. No, sir.

Senator MALONE. After they are ordered, however, then you take over and determine how much of this material you are going to need, and then you pass it on down, or you pass it up to the Secretary, who will pass it on down.

Mr. PIKE. We have an overall review assignment. We have to be certain that the number of planes, the number of wings, for instance, are consonant with the personnel, and so forth; things of that sort, to see that the program is in balance.

Senator MALONE. That is very important, but it does not touch this thing we are trying to do.

Mr. WEBSTER. We have production feasibility, but that is tied in only after the design is decided and the orders come in. We do not come in any time before that.

Senator MALONE. Let me ask the Colonel: Do you design and submit specifications for planes to the manufacturers, or do you merely confine your order to the planemaker for performance?

Colonel CARTER. Operational characteristics or performance of the plane is the normal way it is put out, sir. The design specifications are reviewed, though, by the Research and Development people prior to the time that the order is placed.

Senator MALONE. But you do not design the planes?

Colonel CARTER. No, sir.

Might I add another thing—not to break up your train of thought, and this can be either for or off the record——

Senator MALONE. Yes.

Colonel CARTER. You have raised the question about the commercial applications. I think you will find that in the DC–7, the Douglas plane, and I believe also you will find these in nonstressed applications, and, consequently, there is no question about using pure titanium, it is primarily a weight-saving device; but you do not pick up stress in those titanium parts.

Senator MALONE. You do not pick up stress in certain parts, and that may be what they are using now. But it is not altogether what they want to use, if they could get it.

Colonel CARTER. Agreed. But, again, Senator, the quality of the material governs a whole lot in the application that can be made, sir.

Senator MALONE. I agree. But I have a tendency to disagree with you. I have not studied the evidence; but we will get to it, along with the other members of the committee.

Here you have a metal that, by all the evidence, you cannot make the plane that you really want without it. If you can, I wish you would explain it to me, because we can just get out of this business very fast.

Do you think you can?

Colonel CARTER. I responded to that question before, sir. With the characteristics that you had indicated, I think it probably would require substantial titanium application.

Senator MALONE. I just wanted to emphasize it so that I would not misunderstand.

Colonel CARTER. I think also, Senator, to the best of my knowledge, there have been no occasions when we in the Air Force have failed to authorize an application of titanium that will yield a military benefit to the product.

Senator MALONE. That is very vague. That statement covers a lot of country. You mean, of course, when it is available.

So your statement clears the Air Force, but it puts us right in the middle again.

Of course, you have failed to give the orders for the amount you think is available. You probably ought not to be criticized there, because you probably are not responsible for getting more of it. But I would like to get into the same room sometime with the fellow who is responsible for ordering the planes, the fellow who is responsible for knowing how much titanium you need for the amount of planes, the type of which you really want, and the fellow who is responsible for handing down to Mr. Flemming the amount that could be used in that connection. Then I think we would get some place. I thought I had it this morning, but I do not. Then we will get Mr. Flemming.

If you say you want 36,000 tons or you say you want 136, or 236, then the time to get Dr. Flemming again is when you decide that?

Mr. PIKE. That is right.

I think Dr. Flemming has carried out his full responsibility in this area.

Senator MALONE. I think he has. I think it is right in your own department.

Of course, you are not responsible for it, but I think it is in the national defense.

Mr. PIKE. Top level, as far as material is concerned in the Air Force, is Roger Lewis. And topside in the aircraft engine and aircraft-manufacturing industry, if you get them together, they might be able to answer the question about which you are inquiring.

Senator MALONE. We have to do that, otherwise we are not in very good shape.

Mr. PIKE. I am sure Mr. Lewis will be most happy to cooperate with you in any manner you suggest.

Senator MALONE. Do you know what the people of this Nation believe? They think you are trying to keep ahead of Russia and that you are doing everything in the world to do it. You are assuming you have 10 years of peace in which to get ready and that when you get the mobilization order, then you will suddenly say, "We need this much." But then you will find you cannot get it at all, and you will be trying to fight a war with what you have ready for peacetime.

Mr. PIKE. Of course, we do have a much stronger military position across the board than we ever had in this country.

Senator MALONE. Of course, you do.

Mr. PIKE. Nobody knows when war is going to come. We all pray to God that no war will ever come.

Senator MALONE. I think the way to stop it is to be ready for it. The way to prevent it is to convince everyone else that you are going to win the war, and so they will not start it.

We have not started in this materials thing. The people of this Nation should really understand the condition the country has allowed itself to get into and the policies that have made us depend on foreign shores for critical materials.

Mr. PIKE. I think there is no question, Senator, but your general thesis of getting back to a Western Hemispheric source of critical materials is a very intelligent one.

Senator MALONE. I appreciate your saying that, Mr. Pike. I certainly appreciate the fact that you have come down and have spent this entire morning with us.

The subcommittee will stand in recess subject to call.

(Whereupon, at 11:50 a. m., the subcommittee was recessed subject to the call of the chairman.)

STOCKPILE AND ACCESSIBILITY OF STRATEGIC AND CRITICAL MATERIALS TO THE UNITED STATES IN TIME OF WAR

WEDNESDAY, DECEMBER 8, 1954

UNITED STATES SENATE,
MINERALS, MATERIALS, AND FUELS,
ECONOMIC SUBCOMMITTEE OF THE
COMMITTEE ON INTERIOR AND INSULAR AFFAIRS,
Washington, D. C.

The subcommittee met, at 9:45 a. m., in Room 224, Senate Office Building, Senator George Malone, presiding.

Present: Senator George Malone (presiding).

Also present: Jerome Adlerman, counsel.

Senator MALONE. The subcommittee will be in order.

This hearing has been called in furtherance of the titanium production program, rather, I should say, to ascertain for the benefit of the committee why it is not feasible to proceed with the production of this metal so very important in the air defense program at this time.

Now, the witnesses that have been called will please let us know if they are here, or if they are representing someone who is not here, for the benefit of the record.

Mr. Roger Lewis, Assistant Secretary of Air Force, is here.

Dr. Arthur Flemming, Director, Office of Defense Mobilization, is here.

Mr. Hans Stauffer, Stauffer Chemical Co., of New York, N. Y., is here.

Mr. C. W. LaPierre, vice president and general manager, gas turbine division, General Electric Co., of Cincinnati, Ohio?

Mr. STREID. He is not here. My name is Dale D. Streid. I am representing him here.

Senator MALONE. What is your title?

Mr. STREID. I am manager of engineering of the jet engine department.

Senator MALONE. Of the gas turbine division? General Electric?

Mr. STREID. That is right.

Senator MALONE. Representing Mr. W. C. LaPierre?

Mr. STREID. Yes.

Senator MALONE. Wright Parkins, United Aircraft Co., East Hartford, Conn.?

Mr. THIELEMANN. He is not here, Senator. He will be down here any moment.

Senator MALONE. Roy T. Hurley, chairman of the board, Wright Aeronautical Curtiss-Wright Corp., Woodridge, N. J.?

Mr. HURLEY. Here.

Senator MALONE. Is there anyone else who is here that would like to be heard?

Mr. Gumbel, of General Services Administration?

Mr. GUMBEL. Here.

Senator MALONE. Mr. Gumbel has always been an important witness in all of our hearings.

Mr. GUMBEL. Thank you.

Senator MALONE. He has been very helpful.

Before we ask Mr. Roger Lewis to make a statement, I want to remind all of you that as we started approximately a year and a half ago with these hearings, much of the testimony was rather technical and what the committee wants are the facts in each case.

Therefore, recognizing that in testimony sometimes, the purport of a question, might be misunderstood or you might conceivably have the working information at the time, you may feel free to testify and make any statement that you feel will be helpful to the committee.

I want to remind you that your testimony will be made available to you so that you might correct it for accuracy and completeness.

It will be published and be made available to the public.

What we want, of course, is to have this information for the United States Senate and the Congress just as the Senate Report 1627, submitted to the Senate July 9, is available to all of you. This is under Senate Resolution 271, continuing the work of the committee.

Now, for this particular hearing, it seems that titanium, one of the critical materials, has given us more concern, I might say, than any of the other 77 total materials listed as critical.

We thought in our first hearing that we had established the need for this metal. After a couple of months we heard the rumor around Washington that titanium was running out of our ears; we have more of it than we need, and we are not for letting more contracts.

We had a hearing and we found that the reason it was running out of our ears was because we did not have enough to put in anything. If you started using it you would have enough to last 3 months and then you would be out of it.

Dr. Flemming, of the Office of Defense Mobilization, has been very cooperative. He announced at that hearing that he was as of that date ordering the General Services Administration to purchase the material and stockpile it until such time as the going concern production plus stockpile equaled enough to start using as much as you wanted to use.

That seemed to do all right for a while. Last summer the rumors started again. Someone had used this material and found it was difficult and discarded it. Therefore, we didn't need any more titanium; we had all the titanium we needed, and the program was stymied.

It was established nearly a year ago that we needed 150,000 tons annually to make the kind of planes needed, assuming it were available.

The National Defense Administration has never changed its order for 35,000 tons a year.

However, Dr. Flemming did change his order for 22,500 tons annually to the 35,000.

Now, Colonel McDonald, of Wright Field, testified that they had written out to the manufacturers of airplanes, frames, and engines,

and asked them how much they needed. They reported back and it added up to 35,000 tons a year.

So, there you are.

It developed, however, that the questions they asked were how much was needed to fulfill contracts that had been let already with the amount of titanium that it was now feasible to put in the plane, and naturally they told them they needed just what they had been ordered to put in, which added up to 35,000 or less tons.

Apparently from what I can learn, no one ever asked them how much they could use if the alloys were workable and correct for the purpose, and they had the contracts to manufacture the engines and the planes that everybody knows they need.

So it looked like we were going in a circle.

So, Mr. Lewis, there is only one way this committee knows how to straighten the thing out, and that is to have the people here that are doing the job.

You are charged, I understand—correct me if I am wrong—with securing this material in the amount that is necessary for the construction of the kind of planes you need, bombers, fighters, interceptors, guided missiles, and you are primarily responsible for making the recommendation for any critical material to the Office of Defense Mobilization, Dr. Flemming, who, in turn, can cut down that order or enlarge it, but it must go through him and he can order the General Services Administration to let the contracts.

Now, Mr. Lewis, I think you are familiar with the work that this committee has done already. The committee would like to spend more of its time on something else, not so much on titanium, but we think it is a very critical material.

Tell us what you are doing; what you use as a basis for ordering; the status of the alloys and the use?

STATEMENT OF ROGER LEWIS, ASSISTANT SECRETARY OF AIR FORCE, DEPARTMENT OF DEFENSE

Mr. LEWIS. I appreciate the opportunity to appear before you and express the views of the Air Force on this very important matter.

I think when you referred to my responsibilities as being sponsor for the procurement of titanium that may have been a little narrowly stated. My responsibilities in the Air Force are to provide all of the material, the weapons which the Air Force requires to perform its mission.

Senator MALONE. That includes the material out of which they are made?

Mr. LEWIS. That is right, of which one is titanium.

Senator MALONE. You are responsible for titanium?

Mr. LEWIS. I am responsible for titanium in the same sense that I am responsible for all of the metals and processes and other elements that go into the construction of an airplane.

Senator MALONE. You are responsible for ordering the amount of cobalt you need; you are responsible for ordering the amount of any critical material that you need, or, at least, estimating the amount are you not?

Mr. LEWIS. I am responsible for providing estimates of requirements. I am not responsible for ordering cobalt, for example.

Senator MALONE. Are you responsible for determining the amount you need?

Mr. LEWIS. I am responsible for that.

Senator MALONE. Who orders it?

Mr. LEWIS. In the case of cobalt, it is ordered by the manufacturer of the product in which cobalt is incorporated. We buy an end product and the end product manufacturer, whom we call the prime manufacturer, and with whom we deal——

Senator MALONE. Who does he buy it from?

Mr. LEWIS. He buys it from a fabricator, or some other source of supply.

Senator MALONE. Is it controlled at all?

Mr. LEWIS. Cobalt, I believe, is controlled.

Senator MALONE. Who controls it?

Mr. LEWIS. I do not know who ultimately controls it in the Department of Defense because this is a strategic material.

Senator MALONE. Then it comes back to you, does it not?

Mr. LEWIS. We state our requirements. I am only making a distinction between our responsibility for stating a requirement and responsibility for ordering.

As far as I know, the Air Force does not place any contracts for material such as cobalt.

Senator MALONE. You do not place any contracts at all, do you?

Mr. LEWIS. Yes, we place very substantial contracts.

Senator MALONE. I am talking now about the materials. Do you place contracts to procure these raw materials?

Mr. LEWIS. No.

Senator MALONE. I thought you did not. Then you are in the same position with cobalt as you are with titanium?

Mr. LEWIS. That is right.

Senator MALONE. Whom do you tell how much you need?

Mr. LEWIS. The Department of Defense.

Senator MALONE. Who do they tell?

Mr. LEWIS. They tell whoever is responsible. In the case of these materials they tell the Office of Defense Mobilization.

Senator MALONE. That is what I want to find out for sure today. The Office of Defense Mobilization is responsible for actually ordering the materials, but you are responsible for telling them how much you need; is that right?

Mr. LEWIS. I am very clear on our responsibility for titanium on what we need. I am not completely clear on the responsibility where the actual procurement lies.

Senator MALONE. You are not responsible for getting it because you cannot let contracts for it; is that correct?

Mr. LEWIS. That is correct.

Senator MALONE. But you are responsible for telling the Office of Defense Mobilization, Dr. Arthur Flemming, how much titanium you need?

Mr. LEWIS. That is correct.

Senator MALONE. Is not that substantially all you do with all these other raw materials?

Mr. LEWIS. That is correct.

Senator MALONE. Then we are back where we started from. You are not responsible for securing them, but you are responsible for

determining how much that National Defense Administration is going to need.

Mr. LEWIS. No, the Air Force needs. I am only responsible for the Air Force requirements.

Senator MALONE. Where do they find out how much the Army and Navy need?

Mr. LEWIS. The Army and Navy similarly submit their requirements to the Department of Defense who, in turn, submit them to the Office of Defense Mobilization.

Senator MALONE. Is there any other department using titanium except you now?

Mr. LEWIS. Yes; the Navy uses it.

Senator MALONE. For what purpose?

Mr. LEWIS. Aircraft, among other things. I don't know their whole program.

Senator MALONE. You don't have anything to do with the Navy's aircraft?

Mr. LEWIS. I do not.

Senator MALONE. Do you have anything to do with the Army aircraft?

Mr. LEWIS. We buy the Army aircraft for them, and we would include their requirements for aircraft in their own estimates.

Senator MALONE. The Navy is a little bigger than you are; you do not have anything to do with the Navy?

Mr. LEWIS. I do not.

Senator MALONE. Do you have anything to do with the Marines?

Mr. LEWIS. No, sir.

Senator MALONE. They have not yet set up a new department for just the Marines; have they?

Mr. LEWIS. Not that I know of.

Senator MALONE. There was talk of that for a while. I was not sure.

Does that make any sense to have two departments ordering planes with the same material and then keep separate as to how much you need?

Mr. LEWIS. Yes; I think it does.

Senator MALONE. Who in the national defense gets this information?

Mr. LEWIS. The Assistant Secretary for Supply and Logistics, Mr. Pike.

Senator MALONE. He is not here?

Mr. LEWIS. I have not seen him.

Senator MALONE. Then Secretary Pike is the one that adds up what the Navy needs and what you need and deals with the Office of Defense Mobilization?

Mr. LEWIS. That is correct.

Senator MALONE. You don't deal with the ODM at all?

Mr. LEWIS. Not direct; no sir. We work very closely with them on lots of problems, but speaking strictly as a matter of form; no; we deal with them through the Department of Defense.

Senator MALONE. You really have no authority there at all?

Mr. LEWIS. For the Department of Defense as a whole; no, I do not.

Senator MALONE. All you can do is to tell the national defense,

which, of course, is Secretary Wilson. Who do you address in the Office of the Secretary of National Defense?

Mr. LEWIS. On that matter?

Senator MALONE. Yes.

Mr. LEWIS. I address Mr. Pike. I address the Assistant Secretary of Defense for Supply and Logistics, Mr. Pike.

Senator MALONE. What department is Mr. Quarles in? Is he with you?

Mr. LEWIS. Secretary Quarles is Assistant Secretary of Defense for Research and Development.

Senator MALONE. Where does he come into this deal?

Mr. LEWIS. He is responsible to the Secretary of Defense for all matters dealing with research and development in the Department of Defense.

Senator MALONE. Do you deal with him at all on the practicability of this metal?

Mr. LEWIS. I deal with him a great deal on the practicability of this metal.

Senator MALONE. Maybe we should have him here.

Mr. LEWIS. Well, in matters having to do with the research and development aspect, he is the man with whom we consult.

Senator MALONE. Are you prepared today to testify as to the practicability of this metal?

Mr. LEWIS. I am prepared to make some comments on two aspects of the problem.

Senator MALONE. Now, let us get it straight.

You are not responsible for the Navy at all. You are not responsible for their aircraft. Is that the only place they use their titanium, in aircraft?

Mr. LEWIS. I would not be able to say. I don't know.

Senator MALONE. You do not know they might be making a battleship out of it?

Mr. LEWIS. I don't think they are, but they may be.

Senator MALONE. You do not know?

Mr. LEWIS. I do not know.

Senator MALONE. What you do know is all the uses to which the Air Force and the Army put this metal?

Mr. LEWIS. For aircraft purposes.

Senator MALONE. But you do not know whether the Army might be using it for something else?

Mr. LEWIS. I do not.

Senator MALONE. Who would know that?

Mr. LEWIS. Mr. Pike.

Senator MALONE. He would know?

Mr. LEWIS. The services themselves would know, and I am sure he would know as well.

Senator MALONE. They all report to him?

Mr. LEWIS. In this matter, yes, dealing with requirements.

Senator MALONE. On the use of titanium in aircraft, or would they report on the use of titanium for every use to which they put it?

Mr. LEWIS. They would report for every use.

Senator MALONE. Even the Navy reports to him; is that it?

Mr. LEWIS. To the Secretary of Defense.

Senator MALONE. Do they report to Mr. Pike?

Mr. LEWIS. In this matter with respect to requirements.

Senator MALONE. Every metal, every critical material?

Mr. LEWIS. Correct.

Senator MALONE. I thought the Navy would skip Mr. Pike.

Mr. LEWIS. I do not think so, sir.

Senator MALONE. But they skip you. You do not have anything to do with it?

Mr. LEWIS. They very properly skip me.

Senator MALONE. All right, Mr. Secretary, if you will just give the committee your version of this thing as to what you are using at this time, what you think we should have, and tell us how much of this titanium that you would use in the airplanes in the Air Force and the Army, if it did meet the specifications.

VALUE OF TITANIUM TO AIRCRAFT

Mr. LEWIS. I think, Senator, the first thing I should say, because there has been considerable discussion, as there always is in the case of a new product of this sort, about titanium and its value. I would like to say that the Air Force persists in its view that titanium is a very valuable metal and has a very essential place in the development of a high performance Air Force.

We have persisted in that view; we have always held it and we persist in it today.

Senator MALONE. I do not want to interrupt your line of thought at all, but when you come to it, tell us what titanium does to a plane, why you need it, and what the performance is with it and without it.

Mr. LEWIS. The attraction of titanium to the air weaponry of the country is its resistance to temperatures. As aircraft go faster and as engines operate hotter, a metal that has the strength properties that titanium has and is capable of withstanding temperatures and corrosion is a desirable metal.

At the moment we are of the opinion that when we get to very high-speed aircraft the use of titanium in the structure of the airframe will be essential.

Senator MALONE. You will go into that speed, will you?

Mr. LEWIS. Well, it is a little bit of an open argument at the moment. It is very fast. We don't have any airplanes flying today—I cannot actually make that statement, either, but it is very fast and it is a little difficult to predict when these airplanes will actually be flying in any numbers.

Senator MALONE. It depends a little on when you have the material to make them, does it not?

Mr. LEWIS. It depends a little; yes, sir. You can actually do these jobs with other metals, but they are less desirable because they are heavy.

Senator MALONE. You can't do the job to fly at maximum speeds and make distances without refueling. Now, tell me, can you do that?

Mr. LEWIS. I am sorry; you are talking about today?

Senator MALONE. I am talking about today; yes.

Mr. LEWIS. We are always reaching for more power and reaching for more range and more altitude and more speed.

Senator MALONE. Let me put it this way: If you did not have titanium, did not know anything about it, it was not discovered, can you make a plane that will fly as far and as fast without refueling as you could if you had titanium which you know about today?

Mr. LEWIS. On the basis of what we know today, you can do a better job with titanium than you can do without it.

Senator MALONE. You think when you know more about it it is going to be better all the time?

Mr. LEWIS. With the metal?

Senator MALONE. Yes.

Mr. LEWIS. Yes.

Senator MALONE. That settles that.

Now, tell us how much of it you could use if the alloys were satisfactory and the tests were already run and everything was so you could use it, how much of it you could use to build the planes you want?

You undoubtedly want faster planes; you want the fastest planes you can get. Do you not want the fastest planes that will fly the farthest that you can make with any known metal? Do you not want that?

Mr. LEWIS. Yes, we want the best air weapons that it is possible to attain and the elements that you mentioned, speed, altitude, and range, are critical elements in aircraft weapons.

Senator MALONE. Range without refueling?

Mr. LEWIS. Without refueling; yes, sir.

Senator MALONE. In other words, if another country had a faster plane which would go farther without refueling and a more manufacturable plane, how far would you get with your Air Force without titanium?

Mr. LEWIS. I would not like to comment on that.

Senator MALONE. I think you are the one to do it. You are in the business.

Mr. LEWIS. I am in the business of providing weapons, but a weapon is a complex of things of which the airplane is only one part. There is the pilot to consider; there is the training he is given——

Senator MALONE. That is what I would like to consider, the pilot. I want our pilots to have the best possible planes.

Mr. LEWIS. We are quite categorical about our view that it is important to get the ultimate in performance and to keep as wide a margin over that which any possible enemy of this country might have in these weapons.

Senator MALONE. You know the Russians have written 240 technical articles on titanium that we know about. Is it reasonable to you to suppose, since they secured these German engineers, who already knew how to make it, that they are not making it?

Mr. LEWIS. I have no knowledge on it.

Senator MALONE. It is not very reasonable to suppose they are not.

Mr. LEWIS. I think my job in the United States Air Force is to assume that any possible enemy is as competent as we are.

Senator MALONE. I think you would be a little bit on the offside if you did not.

Now, go ahead and tell us how much of it you need.

Mr. LEWIS. I cannot tell you that at the moment, Senator.

The requirements of all of our materials are under continuous review.

Senator MALONE. I understand that, but is there not somebody in there charged with determining how much of the only metal you can use to make speed, maximum range plane?

Mr. LEWIS. Yes; I can't give you a number now. I started to say these requirements, like requirements of anything in the Air Force, are under constant review because they are constantly changing.

As our war planes change, as the capability of the industry to bring out new engines, new airplanes, develops, detail requirements constantly change, and, of course, total requirements are the sum of detailed requirements.

Now, at the moment, the Air Force is in the process of reviewing its total requirements and for the moment we see no reason to change any estimate that has been made as to total requirements.

But I could not give you other figures because we have not completed the review in process.

Senator MALONE. You see no reason today to tell the Office of Defense Mobilization that you need, if you had the proper alloys and the proper specifications, more than 35 thousand tons of titanium a year; you see no reason to change that?

Mr. LEWIS. I would like to discuss one aspect of this.

Senator MALONE. I wish you would, because this is going to be rough.

Mr. LEWIS. The consumption of titanium so far as been substantially less than we estimated our requirements would be.

Senator MALONE. What is the reason for that?

Mr. LEWIS. The reason for it has been that there have been some disappointments——

Senator MALONE. We understand that. But tell us how much you would use if you had it, because I think we can get it.

Mr. LEWIS. This question is how much can you use when?

Senator MALONE. You will have to let a contract. If you are going to stay with the old amount, there is no use of us bothering with you here.

Mr. LEWIS. I do not know as to that.

Senator MALONE. That is the way it looks to me.

Mr. LEWIS. I would like to make it clear, Senator, and I think this is an important point in your deliberations on this whole matter, that the question of requirements has to be related to time.

Senator MALONE. It surely has, because you wasted 2 or 3 years now.

Mr. LEWIS. You mean I have?

Senator MALONE. No, you have not; I do not suppose, because I expect you have superiors, but the time is wasted.

Mr. LEWIS. Senator, I don't agree with that.

Senator MALONE. And you are wasting it now if you are holding up these contracts and estimating the amount you want that could be let by the General Services Administration that met specifications until you whip the alloys.

It will take a year or 2 years to do that, and 2 years to build the plants, that is 4 years.

Do you want to be responsible for that, or do you want to get it made and have it so when you whip the alloys you have it so you can go ahead?

Mr. LEWIS. I think I would like to express this in the positive——

Senator MALONE. I would like you to.

Mr. LEWIS. We have not been able to use the titanium that has been provided. There is an underconsumption of the metal for technical reasons. We are still completely optimistic about the use of the metal, but we feel that the requirement here which the Air Force has stated has been deferred and delayed.

Senator MALONE. How much are you making now of titanium? Do you know annually at the rate it is being manufactured?

Mr. LEWIS. I have a general idea.

Senator MALONE. Give it to us.

Mr. LEWIS. My idea is that—I will not say at what rate it is being made. I know what its consumption is.

Senator MALONE. What is its consumption?

Mr. LEWIS. About 1,100 tons a year.

Senator MALONE. I cannot tell you exactly the rate now, because it has been stepped up, but the total amount in the last year has been somewhere between 2,000 and 2,500 tons.

A good deal of it did not meet the specifications. I am given to understand now it does meet specifications in hardness.

We will have other witnesses on that score.

I am interested in your telling us why you are only using 1,100 tons and why you want to wait in recommending the manufacture of a greater amount than 35,000 tons per year until you have it all safely worked out?

Mr. LEWIS. Let me answer the first question. The first question is we do not determine how much these manufacturers use.

In the case of an engine manufacturer, or an airframe manufacturer, we buy the airplane and we buy the engine and we require of them the ultimate in performance.

Now, they must make the decision whether or not they can incorporate cobalt or titanium or whatever it is. We pay the bill, but they must make the decision whether they can deliver acceptable products to the Air Force, including such material.

The decisions to incorporate this material into some of the production with which I am familiar, have been delayed by the manufacturers themselves on the basis of their technical appraisal of the practicability of the material.

The Air Force does not make that determination.

Senator MALONE. Did they tell you why?

Mr. LEWIS. Yes.

Senator MALONE. What are the reasons?

Mr. LEWIS. The reasons are that they have had some failures.

Senator MALONE. If they have a failure do they tell you that they do not think it is going to be feasible; that they have no laboratory experiments underway, or tryouts to see if they can arrive at the proper alloys that will stand the work or do they tell you that they do have these things underway and they think within a reasonable time they can use it?

Mr. LEWIS. They tell us there have been disappointments, that the material has proven practicable at a slower rate than they had thought and had hoped; that there has been a delay in the incorporation of the material into their product, but they are still optimistic about its value and its applicability.

Senator MALONE. What is the time element?

Mr. LEWIS. They cannot estimate. One contractor has said he has lost a year already, and he is optimistic about the future, but he cannot make a statement as to how soon he expects the problem to be solved.

Senator MALONE. How many years; 1 year, 2 years, 10 years?

Mr. LEWIS. I don't know.

Senator MALONE. You do not know? You do not know anything about it. You have not asked them?

Mr. LEWIS. I have not asked them that question.

Senator MALONE. What would be the objection of men in your position trying to find out how much titanium or cobalt, you will be using in 1 year, 2 years, or 3 years?

Would there be any objection to a man working for the Government to telling us how much of this material we are going to need? It is going to take 2 years to build the plant.

Did that ever occur to you?

Mr. LEWIS. It occurred to me. It is one of my responsibilities and we are trying to do it.

Senator MALONE. You did not ask the producers?

Mr. LEWIS. I did not ask the producers the specific question whether it would be delayed, 1 year, 2 years, 5 years, or 10 years.

Senator MALONE. Is not that one of the first things you have to know?

Mr. LEWIS. One of the things.

Senator MALONE. The first thing. In other words, if they are getting ready to use it within a year and it is going to take 2 years to build a plant and they know now the specifications are all right, and so on, it is a question of alloys, and you are going to do it in a year, it takes 2 years to build a plant, is that the way we run the business up there, and you are not going to let any more contracts until you get the alloys worked out and then it is 3 years to get the plant? Is that your idea?

Mr. LEWIS. My idea is this, that the Air Force makes some estimates which they turn into the Department of Defense, which are turned in to the Office of Defense Mobilization on requirements relating to time, which have turned out to be wrong. We do not know the degree to which they are wrong.

Senator MALONE. You mean you ordered more than you needed?

Mr. LEWIS. In time, yes. We ordered it faster than we could use it in relationship to time.

Senator MALONE. Have you ever taken that other time element into consideration, that you are going to have another couple years after you reach the point before you can get it?

Mr. LEWIS. We take that into consideration.

Senator MALONE. You said you never asked them.

Mr. LEWIS. That is a different question, sir. You asked me an estimate from manufacturers of the delay in the production of this by periods of 1 to 10 years, and I do not have that.

Senator MALONE. Do you not think it would be a good idea to ask them?

Mr. LEWIS. Certainly it would be a good idea. It is part of the general study that is going on right now, but I do not have that information today.

Senator MALONE. As long as you are not going to ask the producers who are running these tests, how long does it take you to make up your mind there? Another year?

Mr. LEWIS. It is not a matter of my making my mind up.

Senator MALONE. Whose is it?

Mr. LEWIS. It is a matter of this whole technology of this country being able to develop for us and making available to our manufacturers a practical metal.

Senator MALONE. All right, you want to be entirely practical before you order any more of it, knowing it is going to take 2 years from that time before you can get it.

Mr. LEWIS. I didn't say that.

Senator MALONE. You certainly said you did not see any reason for ordering any more of it and you ordered more than you should have ordered because they have tried it out and it did not work.

Mr. LEWIS. I don't recall saying that.

Senator MALONE. It is too far to turn back to the question. I will ask you now: In view of the fact that they say that the manufacturers' sponge is meeting the specifications now, that the metal is meeting the specifications, but the alloys are not as yet, but they think they can work them out in a reasonable time—I know some of them will testify to that—it is a question, then, whether you think you should wait until the alloys are worked out, until all of it is practical, then you will tell the Office of Defense Mobilization, which, in turn, relays it to General Services Administration, that you can now go ahead and make contracts for 50,000, 100,000 tons which you will need after those alloys are practical.

Then it takes them about 2 years to get a plant built which shall be added to the time it takes to work out the problems of alloy and fabrication.

Is that your idea of building a national defense setup?

Mr. LEWIS. Senator, I want to make this very clear for your record: We have not changed our stated requirements.

Senator MALONE. I know that, and you have not changed your order to the defense organization.

Mr. LEWIS. But we at the same time recognize, because it is a fact, that there has been a delay in the development of this metal which has reduced its use in our end production.

We do not know and we are studying at the moment, what the effect, if any, this would have upon the requirements we have stated.

Senator MALONE. You do not know, for example, that if the alloys are worked out satisfactorily so you can make the engines, you can make the frames with 25 to 40 percent inclusion of titanium, which is testified by the makers of the engines and the frames, you do not know that if you suddenly had all that you wanted how much you would use? That is, you do not know within a hundred or two hundred percent how much you could use?

Mr. LEWIS. Senator, if there were no problems our present estimate would be perfectly valid.

Senator MALONE. You think that would be all you would need?

Mr. LEWIS. In this time period.

Senator MALONE. I think that is enough. You just stay with us for a while until we hear a couple other witnesses. We will probably hear you again.

Mr. LEWIS. Yes, sir.

Senator MALONE. Mr. Hurley, will you come forward, please.

You are chairman of the board of Wright Aeronautical, Curtiss-Wright Corp., are you?

STATEMENT OF ROY T. HURLEY, CHAIRMAN OF THE BOARD, WRIGHT AERONAUTICAL, CURTISS-WRIGHT CORP., WOODRIDGE, N. J., ACCOMPANIED BY HERMAN H. HANINK, DIRECTOR, EXPERIMENTAL PROCUREMENT MANUFACTURING, CURTISS-WRIGHT CORP.

Mr. HURLEY. Right.

Senator MALONE. You have been a witness before the subcommittee a couple of times. The first time you heard certain witnesses testify as to the need for titanium metal to be worked out with alloys under certain conditions under which it could be used.

It seems to me the last time you were before the committee you had a plan worked out for using titanium metal as it became available.

Your plan was that tests were made on certain parts to go into the engine and not try to make the entire engine with 50 percent titanium, 20 percent, or 10 percent; but to be sure that you would have the amount of titanium you needed, with the tests keeping up with the production, and when you put a part made of titanium in the engine, it stayed there. Regardless of that part of it, I would like for you, as a substantial contractor in the engine field, to give us the story on titanium as you see it; as to the amount you think can be used in industry, if it meets the specifications, and how you think you could use it.

Mr. HURLEY. Senator, we have not changed our thinking at Curtiss-Wright. We have been a little slow in getting started on the use of titanium, but we have been making a profitable investment in time to integrate our extensive corporation knowledge of forging, casting, and extruding techniques into our titanium program to insure minimum cost of titanium application.

It is our feeling that the way to get titanium into an aircraft engine is to examine the alloys, select the parts we think they are suited for and then, piece by piece, test the material both in the laboratory and in the engine to determine that our selection was sound.

If the parts can be produced at reasonable cost, and if they are justified by the above testing, then we think they should go into the engine and stay as an item of production.

Senator MALONE. What would the cost have to do with it if it made a faster plane and you needed it for national defense?

Mr. HURLEY. As I have testified before, we look at cost as a word used to indicate the number of men and machines required to produce parts. If the parts cost too much, that would be an indication that the men and machines needed would be excessive particularly under conditions of total mobilization. We have a formula which I believe is in the record which indicates our concept of the economics of titanium usage and which we propose to use in determining the economic desirability of specific titanium applications.

I don't remember the details of our formula but it involves amortization of costs based on economies in airplane operation resulting from the use of titanium.

It involves factors which I think have been generally used by others in the industry.

Senator MALONE. Go ahead and give it to us again, Mr. Hurley.

Mr. HURLEY. The quantities I gave you with respect to our proposed use of titanium were reported at my last appearance before the subcommittee. We still think we can use those quantities if we get our program underway.

We expect this month, before the month is out, to apply power to our extrusion press for the first time. It is my opinion that if we combine that extrusion knowledge with the work we have done on the machining of titanium that we can use the quantities of metal proposed in an initially limited number of parts.

Senator MALONE. Do you have that now?

Mr. HURLEY. Our proposed use was indicated with a rate of buildup from the beginning of our program by the month and by the year.

Mr. HANINK. The peak which we indicated based on current planning as to engine models and engine production was about 500 tons per month.

Senator MALONE. Will you identify yourself, for the record?

Mr. HANINK. Herman H. Hanink, director, experimental procurement and manufacturing, Wright aeronautical division, Curtiss-Wright Corp.

Mr. HURLEY. That is based on our solving the problems we have talked about.

Senator MALONE. If you had had the order to go ahead——

Mr. HANINK. If we had been able to go ahead with the assurance of supply and the development of manufacturing methods to provide reasonable economy in materials and labor we would have done so in accordance with the buildup curves which Mr. Hurley presented as an exhibit to this subcommittee in a report entitled "The Production Use of Titanium in J65 and J67 Turbojet Engines."

Senator MALONE. Five hundred tons a month would be used at the present time.

Mr. HANINK. That would be about 6,000 tons a year. Actually, there are some numbers higher than this which were mentioned in Mr. Hurley's testimony but he was also speaking about propellers and other aircraft components being produced by the various divisions of the Curtiss-Wright Corp.

Senator MALONE. Now, you are just one engine company. How many are in this business?

Mr. HANINK. Five, I believe.

Senator MALONE. Would the other engine companies, under the same conditions, with the number of engines they are producing, use some that you are not using?

Mr. HANINK. We gave you numbers reflecting current and proposed engine contracts without relation to other estimates based on conditions of full mobilization.

Senator MALONE. Are these others as big in the field as you are?

Mr. HANINK. I am not familiar with the numbers.

Mr. HURLEY. I think the companies are fairly well balanced.

As to how much titanium they use, I don't believe we are qualified to say.

Senator MALONE. I am talking about the number of engines they are making in which titanium could be used.

Mr. HURLEY. We feel we can solve the problems as outlined and based on that we believe the use of titanium will build up and stay in production as a fixed requirement.

Senator MALONE. That would be for the engine companies alone, then, around 30,000 tons annually.

Now, how would you propose to do that? How would you have done that if you had been allowed to go ahead on your proposal and when was this proposal made?

Mr. HURLEY. This proposal was made at the time of your hearing, 7 or 8 months ago when I was here before.

Our plan was to select the alloys available to us and then after studying them in the laboratory, to select the engine parts we thought could be made from the most suitable of these alloys.

Senator MALONE. One part at a time?

Mr. HURLEY. One part at a time.

Senator MALONE. I remember the testimony.

Mr. HURLEY. And by methods of extrusion or forging arrive at a piece that could be machined for a reasonable cost.

As a result of that study if the end cost of that part was satisfactory, we would then make a limited quantity of those parts; we would put them in the engine for test. If they showed up satisfactorily during engine test, and if the cost were acceptable, then we would recommend putting the pieces into production and stay in production from then on out.

Senator MALONE. But you would let that contract on a proposal from the National Defense Administration based on the supplies of titanium so that you could keep that part, or those parts, in the engine.

Mr. HURLEY. Once a piece goes into production it should stay. I think our program involves a combination of decisions on the part of research people as well as production groups and other activities in the Government.

I believe Curtiss-Wright has a broader scope in its approach to titanium than the other engine builders, because we do operate a forging shop and foundry and we have done considerable extrusion work in the last few years.

Senator MALONE. What is your opinion of the availability of these parts? They have been held up?

Mr. HURLEY. If a production program such as we have proposed were launched, we would get very close to our projected use of the parts included in the program.

Senator MALONE. You are familiar with the fact that the engine companies have had certain failures?

Mr. HURLEY. That is right. We have had some failures in the work we have done, too.

Senator MALONE. I do not want you to criticize any other engine company. We will hear from the other companies. Why do you think yours will work when theirs failed?

Mr. HURLEY. We think in our proposed program that we too would encounter difficulties in our investigation of the use of titanium for a part. We would then sidetrack the part, so to speak, and would proceed only with those parts with which our experience was successful.

Senator MALONE. Do you have any parts now that are feasible?

Mr. HURLEY. We have some parts that we tested and we think are practical.

Senator MALONE. And you are ready to put them in if you knew the supply was available?

Mr. HURLEY. We have reached the point of putting a few parts into what is considered a type test, with flight test and then production as the following steps.

Senator MALONE. Now, you are only talking about engine companies and you are up to 1,000 or 2,000 tons a year. You heard the testimony awhile ago that you are only using 1,100 tons a year and you are manufacturing more than 2,000, therefore, you are manufacturing more right now than you need and there is no idea now of increasing their requirement.

Mr. HURLEY. I think it is a matter of obtaining a meeting of the minds of those connected with the industry and the problem.

Senator MALONE. How did minds meet? Have you discussed it with anybody in the National Defense Administration?

Mr. HURLEY. Our people have from time to time and they have a program from us now that, I believe, is part of their survey and they have our recommendation as to what we think should be done.

Senator MALONE. If they took your recommendation, does that come under the 1,100 tons available?

Mr. HURLEY. No. Our recommendations are in the future, Senator, not in the past.

Senator MALONE. Now, you testified if we had started last year, whenever we started talking about it, that you would have been up to 6,000 tons use annually, this year.

Mr. HURLEY. We think about a year's program would result in that consumption of metal. It depends upon our putting the extrusion equipment into operation.

Senator MALONE. If you had put it in last year, you would have been ready now. If you put it in a year from now, you will be ready a year from then?

Mr. HURLEY. That is right.

Senator MALONE. In the beginning of this committee made a statement through the chairman that I think we can sell it to the Senate if we can show first, that you need it; next, that you can work it out, and will order the things you need. You cannot sell a thing that nobody is for. I cannot find anybody for it that is in authority.

Mr. HURLEY. We are certainly for it.

Senator MALONE. We do not have Mr. Pike here this morning. We have his testimony some place.

What does he say there? Mr. Pike said about a half dozen times that he asked the users how much they needed. Evidently, as I tried to sum up his testimony while he was here, that he got back what he had sent out already. He ordered the engines with so much titanium. He asked them how much they needed. They sent it right back.

Did anybody ever ask you the question I have asked you: How much titanium you could use if available and met your specifications?

Mr. HURLEY. Yes, the consumption curves we have quoted and which you have in the record we have also provided to the Air Forces.

Senator MALONE. Now, has the National Defense or any administration or any representative of it, asked you how much you could use if they let you go ahead on these alloys? Have they asked you now?

Mr. HURLEY. After my testimony here at the prior hearings, the request was made and we have presented several studies to them.

The studies are now under consideration, Senator.

Senator MALONE. Is this the first time they have been under consideration?

Mr. HURLEY. No, they have been under consideration for some time.

Senator MALONE. A year?

Mr. HURLEY. No, I would say several months.

This business of coordinating a thing of this kind, I recognize, is a pretty complex one. There are many agencies and many problems involved.

Senator MALONE. Do you think the agencies ought to be cut down a little?

Mr. HURLEY. I do not know. I feel that all of the Government agencies have had some restrictions on them and there are too many coordinating branches. I feel quite sure of that, Senator.

I have had experience in and out of the Government service, and we seem to acquire more and more as the years go on, and it takes us longer and longer to get things under way and released.

I think that is the common experience of everybody in and out of Government.

Senator MALONE. You heard the testimony this morning that the Assistant Secretary in charge of coordinating the Army and the Air Corps and informing the National Defense Administration what they need would not change the amount already ordered, with the information you now have.

Mr. HURLEY. We feel very confident of our position and we feel very confident of our ability to do what we have outlined.

Senator MALONE. If it was ordered now, when would you reach that 500?

Mr. HURLEY. I would say in a year.

Senator MALONE. How much would you reach in two years?

Mr. HURLEY. It depends on the engine program——

Senator MALONE. We are assuming we need engines, or we would not be here.

Supposing you had all the contracts you could handle. Forty-eight hundred tons in 1955. How much in 1956?

Mr. HURLEY. As our contracts would increase the use of titanium would increase with them.

Senator MALONE. They are talking now about the contracts. I am talking about the increased amount of titanium, for engines.

Mr. HURLEY. We think in 2 years we would be up pretty close to the maximum use of titanium per engine.

Senator MALONE. How much would that be per month?

Mr. HURLEY. I have a figure per engine. I don't know what our total capacity would be. I would estimate roughly a ton per engine.

Senator MALONE. How many engines——

Mr. HURLEY. That is a ton of rough stock per engine.

The number of engines for that advanced period is not determined.

Senator MALONE. Is that information classified, Mr. Secretary?

Mr. LEWIS. You are talking about a period 2 years hence.

Senator MALONE. This year. How many of these jet engines are under contract right now with Curtiss Wright?

Mr. LEWIS. I think I can give you that number. I don't have it at my fingertips, but I will be glad to furnish it to you.

Mr. HURLEY. The contract for 1955 would be of limited value because this work which would be done during calendar 1955 now would

be engines for 1956, and I don't believe that is determined at this time.

Senator MALONE. Give us some figure out of the air of the number of engines annually, 500 or 5,000?

Mr. HURLEY. If we were to run along at our present operating level our consumption would be in accordance with the consumption curves we have here.

Mr. HANINK. This consumption curve is for one engine model only.

Senator MALONE. How many engines do you have under construction?

Mr. HURLEY. If you wish to use 200 engines a month as an assumption——

Senator MALONE. That would be 200 tons a month. If it were 400 engines a month, it would be 400.

Mr. HURLEY. That is right.

Senator MALONE. You are assuming, and I will ask this question: You are assuming that the alloys will be satisfactory and you can work them out satisfactorily within a year part by part. Do you have any doubt about that?

Mr. HURLEY. No; we do not.

I say that based on past experience. I look upon titanium as I look upon steel. There are places where you would use carbon steel, places where you use nickel alloy steel, and places where other specific alloys must be used.

We believe that the technology has to be developed to use any material properly. Each material must be studied in order to direct it properly toward its end use depending upon operating conditions. No one material is best suited for all conditions such as low stress, high stress, low temperatures, high temperatures, etc.

We think at this time that there are some parts that titanium should not be used for and for which we would not consider it.

But as time goes on other techniques will be developed that will allow us to use titanium on those parts.

Senator MALONE. That depends on engine tecnhique?

Mr. HURLEY. That is right.

Senator MALONE. But you think the time element in making these workable parts available is about a year for a few of them, in another year or two you will get up to the maximum.

Mr. HURLEY. Yes.

Senator MALONE. What is the maximum percentage that will be made out of titanium?

Mr. HANINK. Based upon dry engine weight, about 10 percent on a conservative basis. This figure may range up to 25 percent depending upon the development of certain alloys.

Mr. HURLEY. If I may, I would like to point out one thing on our proposal. I think it is a mistake to consider that we are going to put into production right now, as of today, X percent of titanium in engines. I think it would be a mistake for the airframe builder to design an airframe today and say this is going to be it.

My recommendation is that the interested Government agencies set up paralleling programs with the aircraft industry to determine which of the parts now in production of steel, aluminum, or other material can be replaced by titanium parts. As work would be completed in

the paralleling programs we would then place qualified parts into production and keep them in production. As the engines got lighter and lighter through substitution of titanium the airframe designer would then be able to take advantage of it knowing that it would be a permanent situation.

I think if I were the airframe builder I would try to use the titanium the same way.

Senator MALONE. I think the testimony was along that line somewhat. I think we had testimony that when you save a pound in a certain part of a plane, that if you know ahead of time you are going to save that pound it amounts to 8 or 10 pounds saved in the whole plane; is that not right?

Mr. HURLEY. Yes, from 6 to 10 pounds is the range by experts in the industry.

Senator MALONE. That being the case, in order to do that it is necessary that the frame makers know exactly what your engine is going to do with the horsepower and then the horsepower you make fits the weight of the plane which decreases as the plane weight decreases, so it is an overall operation.

Mr. HURLEY. That is right.

Senator MALONE. So there should be a meeting of minds undoubtedly, as to just how and to what extent each plane is going to be manufactured with a lighter plane engine.

I have some figures which I want to make a part of the record. Mr. Cullen, of the Department of Commerce, has estimated that the sponge production for 1954 is actually 5,000 tons.

The use in 1954 is 2,400 tons to produce about 1,250 tons of mill products—that is where the waste comes in and they are unable to use the scrap.

The stock, the revolving fund of the stock, at the end of the year, will be 2,400 tons.

Estimated production in 1955 will be 10,000 tons.

This is for what it is worth.

We found suddenly that the Department of Commerce was concerned, too. We do not know yet whether we have found all the agencies that will have something to do with it, but I think in the long run we will, and get a new start next year.

I want to say at this point, too, just speaking for the chairman, I am greatly perturbed about this particular thing. In all other critical materials everybody is working in a free-hand manner trying to get it done.

Go ahead, Mr. Hurley.

Mr. HURLEY. Senator, we have submitted a proposal to the Air Forces which provides for a study of titanium alloys, manufacturing methods, and engine usage. We are confident it will be approved and released as we think it should be and under that proposal we will be able to move as rapidly as we can. We expect to take full advantage of the failures that we and other people have experienced and which I believe have not been unexpected by all of us.

Our proposal presents a program paralleling our production engine program with a piece-by-piece feed back of qualified titanium parts into the production program.

The Air Force has to have combat readiness at all times. I personally feel that all titanium application programs should be paral-

leling programs and not direct production programs. I don't believe that paralleling programs will slow down the use of titanium a bit; in fact, I think it might speed it up.

The program which I am proposing might require some coordination between several Government agencies. I am not familiar with where the funds may be placed. They might be considered production funds, research and development funds, or some other fund you would normally use for the production of aircraft.

Senator MALONE. Do you know any law which would prevent Government departments working together?

Mr. HURLEY. No, sir; I do not.

Senator MALONE. Well, it is against precedent. But you do not know of any law that Congress has passed preventing that?

Mr. HURLEY. None at all. It is purely a matter of availability of funds, Senator.

Senator MALONE. Has there been any scarcity of funds? Has the Congress ever refused to appropriate any money for this investigative type of work, that you know of?

Mr. HURLEY. I have no knowledge of any such limitation; no, sir.

As you said, everything we can do to reduce weight means more range and more performance. I know as fast as we can reduce weight and give more performance they have places and ways they can use that to increase combat effectiveness.

Senator MALONE. You have not been given the go-ahead signal?

Mr. HURLEY. That is right.

Senator MALONE. I think that is pretty generally understood by some of the other plane manufacturers, too.

Mr. Hurley, would you stay with us a little while?

Mr. HURLEY. Yes, sir.

Senator MALONE. Now, Mr. Wright Parkins, of the United Aircraft Co. of Hartford, Conn.

Mr. Parkins, you have heard the approach that the subcommittee is making on this problem. I am sure you have had available the report of the committee which is their approach to the whole critical material problem.

The subcommittee is very earnest in this work, and they do not intend to let up on it because the history is too dangerous, the history of critical material production in this country is just too dangerous.

It shows that at different times it has been actually delayed by desire. So that other nations are ahead of us in many of the materials. There is a move on foot now, as I say, to accept the Japanese titanium as part of our needs. That is to say, reduce the tariffs so that with a 15- or 20- cent-an-hour labor over there there is not much question but that you would not be in business very long here.

Would you identify yourself for the record and proceed in your own way?

STATEMENT OF WRIGHT PARKINS AND R. H. THIELEMANN, OF PRATT WHITNEY, DIVISION OF UNITED AIRCRAFT CORP., EAST HARTFORD, CONN.

Mr. PARKINS. I am Wright Parkins, manager of engineers at Pratt Whitney Aircraft.

I have with me Mr. Rudy Thielemann, who has been experting in the titanium phase of our activity.

What I have to say applies strictly to Pratt Whitney Aircraft.

Senator MALONE. We do not want anyone to criticize anyone else. All we want is to give you an opportunity to coordinate all the testimony. I am sure you know that.

Mr. PARKINS. Speaking for myself and the division as a whole, we are extremely bullish on titanium. However, we are terribly disappointed in having experienced some setbacks.

DIFFICULTIES IN USING TITANIUM

We thought we would be much further along in the use of titanium today than we are, but it is only because we are pioneering in a new metal field. We have encountered difficulties that we did not anticipate, so we are not as far along in our program as we had originally planned.

These difficulties, let me say, are not insurmountable. As we have run into them we have found solutions.

First, it was the production of the metal itself. Now we thought—you spoke of the specifications—we thought when we ordered the material initially that we had sound specifications. It later developed, through lack of knowledge, that the specification was not sound, so we had to start over again.

The next difficulty we experienced was in the forging of the material. I brought along an example so you can see what the problem is. Look at that. At the base of that blade you will see some checkmarks. Those are forging laps which we do not experience in forging stainless steel.

Therefore, we have the forging technique to work out. The unfortunate part of it was we did not know about this peculiarity. Normal and ordinary inspection methods did not uncover it. We got into production, we produced these parts in production quantities and we could not use them because we could not pass our test requirements.

We are perhaps in the unique position of having all the go-ahead that is needed from the military services.

The problem is strictly in our lap. I cannot think of anything more useless than an airplane that won't fly.

Of course, if the blades break in the engine, that is exactly what happens. So we don't want to be guilty of delivering engines that are going to break up early in the game. They have to be good engines.

Senator MALONE. I do not know any plane more useless than one that will not fly, as fast or be quite as maneuverable as the fellow you are fighting.

Mr. PARKINS. Let me say, too, that we are counting in a large measure on titanium in our advanced programs—I can't talk specifically about those because it is all classified material—but in our advanced programs we are counting heavily on titanium. I do not know what we are going to do without it. It really has remarkable physical properties.

One that has not been mentioned, and I would like to mention it around this table, is that a titanium compressor blade has about two-thirds the vibratory stress of a stainless steel blade, yet the titanium has as high fatigue endurance as steel, and we are hopeful that some day it will have higher fatigue endurance than stainless steel.

We think we have only scratched the surface in titanium alloys.

Senator MALONE. That one thing ought to be quite an asset too, that other metals do not have, if you can whip into shape the proper alloys.

Mr. PARKINS. That is right. The whole difficulty at the moment is that we are pioneering in a new metal field and we must expect a lot of difficulties.

One of the most important things, Senator, is to get some engines in the air, a few only in the air, and flying under actual service operations, to find out what other things we have not yet uncovered that will have to be corrected before we go into a full-scale production program.

Senator MALONE. Did you not have this same, or did not they have the same difficulty with the use of stainless steel and aluminum and some other metals as they came along?

Mr. PARKINS. Yes; they did. We had to learn how to use them.

Senator MALONE. You had to find out what the problem was and then you had to make something to fit.

Mr. PARKINS. That is right. We are going through that stage right now.

Senator MALONE. Do you have any idea but what you will whip this thing if you are just turned loose as you now are?

Mr. PARKINS. We are turned loose.

Senator MALONE. I say, if you continue that, do you have any idea that you will whip it?

Mr. PARKINS. We see nothing today that leads us to believe that we can't use titanium to greater advantage.

Senator MALONE. You heard Mr. Hurley's testimony of testing certain parts, not trying to make an entire engine, but to test a part at a time and if it is satisfactory it stays in. Do you think that is a practical approach?

Mr. PARKINS. Yes; I don't think we will use the full potential of titanium for several years. I think we want to crawl before we walk, and walk before we run, in this program, just to make sure that we are not building up big quantities of titanium in engines that are not going to work.

Senator MALONE. In other words, you want to test in each case—you heard Mr. Hurley testify that maybe a year would put them into production, another year they would increase that amount—you go along generally on that kind of program?

Mr. PARKINS. Yes. I put some figures down here that might interest you.

Our present program on titanium involves about 300 pounds of finished material per engine. At the present time our ratio of finished to rough material is approximately five.

So let us say that in rough material we are using 1,500 pounds per engine. That is three-quarters of a ton.

If we were to shift over all of our requirements, all of our jet engine production requirements to titanium, that would involve at our present rate, somewhere in the order of a thousand tons per year.

Now, let us look ahead. We will make some assumptions. Let us look ahead 5 years and let us assume that on the average the present type of engine will weigh in the neighborhood of 5,000 pounds, in round figures.

Let us also assume that we can save in weight over steel 20 percent. I think in 5 years' time that will prove to be a conservative figure.

My arithmetic says, then, there will be 2,500 pounds of titanium in each of those engines and again making an assumption on the ratio of rough to finished weight of 4 we will need on the order of 10,000 pounds, or 5 tons of titanium per engine.

Senator MALONE. What would that be in a percentage of weight?

Mr. PARKINS. Well, titanium weighs about six-tenths that of steel. I said that we stand to save about 20 percent, which is a tremendous saving. It is something that this country cannot overlook.

Senator MALONE. That 20 percent saving in weight, worked backward in fuel and range, is a terrific thing, is it not?

Mr. PARKINS. It is, so I am told by our airplane customers.

Senator MALONE. Of course, you understand the testimony has been that if they know you are going to be able to save that much weight, and they know how much weight they can save when they are designing the airplane, then the wingspread and the weight of the plane is materially reduced and, therefore, for the same speed and same range your horsepower is reduced if you want to reduce it, or you can speed it up and you can fly farther.

Mr. PARKINS. You can.

Senator MALONE. In order to do this job—your testimony is very important here—your opinion is that if you are going to meet other nations on an equal basis in any future war, that this is a must. Would you say that?

Mr. PARKINS. It is a must if they can use it. It is a must that we must have it.

Senator MALONE. If they have it, we have to have it, or we would get whipped.

Mr. PARKINS. That is right.

Senator MALONE. In other words, you have a second best poker hand. That is the only reason this committee is spending this time on it.

You heard the chairman mention that we know of 240 research articles that the Russian people have written on titanium. If you write that much about it together with German engineers and others who were available to them after World War II, is it not a reasonable assumption they know something about it?

Mr. PARKINS. I think so. I thoroughly agree with Secretary Lewis that we can adopt no other attitude.

Senator MALONE. As far as the planes are concerned, you do not care where the titanium comes from, but if it was not available when war stated, it would be a little unhandy, would it not?

Mr. PARKINS. Yes.

Senator MALONE. That is the committee's interest in it.

Go ahead, Mr. Parkins. I am extremely interested in what you have to say.

Mr. PARKINS. About the only other thing I have to contribute is to assure the committee that we are working strenuously in trying to get the maximum of titanium in our production.

Now, there are some other problems yet to be solved. We have the problem of welding titanium. Until we solve that problem we cannot use it to its maximum extent.

Senator MALONE. Do you see anything that would prevent solving the question?

Mr. PARKINS. I will let Mr. Thielemann answer that question.

Mr. THIELEMANN. The problem of welding titanium——

Senator MALONE. Do you see anything that is insurmountable in putting it together?

Mr. THIELEMANN. No, there isn't.

Senator MALONE. What is the weight of one of these engines that you are manufacturing now?

Mr. THIELEMANN. They average about 5,000 pounds, do they not?

Mr. PARKINS. It is about 4,000 pounds.

Senator MALONE. Four to five thousand?

Mr. PARKINS. Yes.

Senator MALONE. You would have 2,500 pounds of titanium per engine when you reach what looks like now would be the ultimate.

Mr. THIELEMANN. That is right.

Senator MALONE. What is the time element in your opinion if they continue to give you your head on this thing?

Mr. THIELEMANN. The time element depends on whether you are talking about experimental usage or production. Timewise we are trying to do some of these things now, experimentally.

Senator MALONE. I am merely talking about the use.

Mr. THIELEMANN. I agree with Mr. Parkins it is going to be 2 or 3 years.

Mr. PARKINS. Some parts before.

Mr. THIELEMANN. Yes. We hope to have production engines out next year.

Mr. PARKINS. Knowing what we now know and if we don't run into any more snags, they will start rolling off the line next year.

Senator MALONE. How much titanium would you use next year?

Mr. PARKINS. It amounts in raw material to around three-quarters of a ton per engine.

Senator MALONE. You are talking of raw material; is that sponge?

Mr. THIELEMANN. Bars, billets, and forgings.

Senator MALONE. That would be 300 pounds you would use in an engine. That is good progress.

Mr. PARKINS. We have worked mighty hard on this problem because it is so important to the national defense.

Senator MALONE. I think it is indispensable. I am saying now, from the evidence, indispensable to the national defense and, naturally, any company that make the greatest progress is going to be the greatest manufacturer of engines. That is the way to do business in this country.

Now, in your engine manufacturing for national defense, is there any information available to other companies that you would work out, or available to you from other companies that they would work out in the use of titanium?

Mr. PARKINS. I think we can answer that in the affirmative. I think I can testify that anything we work out would be available to any other engine company.

Mr. THIELEMANN. The interchange is not only between the aircraft manufacturers, but between the services as well.

I would like to say something along this line. The titanium industry can now produce more metal than it can sell and we are stock-

piling a little more than what we are using. But, in our eyes, it has only been in the last 6 months that the industry itself knew how to make the kind of product that we could use. The hydrogen problem, and the double-melting problem has been solved; 6 months is an awfully short time in the development of a brand new metal when you are going to try to replace steel that has been in production for years and years.

If you take a large perspective of the overall picture, I don't see anything wrong with anything that has been done up to now.

The minute titanium starts to work, the whole picture will change, and we will be crying for a lot more titanium than we are now able to produce.

Senator MALONE. You think it will be starting to roll next year. If you do get 1,500 pounds in an engine, next year, would you say 2 or 3 years you will be up to 2,500?

Mr. THIELEMANN. 1955 for us is going to have to be the year when we get production engines out and when the Air Force gets experience with them in flying. We have to get enough engines out so they can tell us, "Yes, it is good," or that we have some more work to do.

Senator MALONE. It has gotten to be a kind of mystery around Washington. Reports seep in that Pratt Whitney has discarded the use of titanium; they could not make it work, and we had it running out of our ears and there was no use letting more contracts. There is nothing like that that came from your company?

Mr. THIELEMANN. Not from our company.

Senator MALONE. It has gotten around.

Mr. PARKINS. We pushed our schedule back time and time again.

Mr. THIELEMANN. I don't think any of us at Pratt Whitney ever even intimated that, any place, in any meetings.

Senator MALONE. Now, you have the evidence before you and you know how fast this sponge is being produced. You know this is a little disappointing even for me. I thought we were doing it a little faster than Mr. Cullen said we were. I thought we were manufacturing 2,400 tons of this sponge.

Mr. THIELEMANN. The rate today is 20 tons a day.

Senator MALONE. I think out in Henderson we had just reached the 10 tons per day meeting specifications.

Now, they are after another contract which they should get, of course.

But you do know that the National Defense Administration has not changed their requirement for a year and a half. They set 35,000 tons. They still think that is all they need. You understand it takes about 2 years—we had testimony on that; we will have some more—to build a plant and to get into production.

In other words, we suggest, knowing that we are going to whip this thing—we always do—it is necessary we know that is what we are going to need and we know that is more, the amount we put in the frames and in the engines, than the 35,000 tons.

Would you suggest that we wait until we whip these problems next year, or the year afterward, and then let these contracts?

Mr. THIELEMANN. I am glad they didn't stockpile any more than they have until now, because a lot of that stockpile is never going to be used.

FUTURE REQUIREMENTS FOR TITANIUM

Senator MALONE. You mean it does not meet specifications?

Mr. PARKINS. As we have them written now. It did at the time.

Senator MALONE. I said in that statement if it met specifications, it will work.

You know now what will work.

Mr. PARKINS. We think we do.

Senator MALONE. We understood thoroughly that when they let the first contract to the Titanium Corp. it was something over 200 hardness, 225.

Mr. THIELEMANN. That is right.

Senator MALONE. They did not know then they would need 160 or 150, but now the specifications have been rewritten and they are all meeting it.

Mr. THIELEMANN. Our specifications for the alloy we hope to use this year specify that they cannot use anything harder than 140.

Senator MALONE. Are they making it now?

Mr. THIELEMANN. Yes, sir.

Senator MALONE. Then you have the specifications that you now know that you want and the National Defense Administration undoubtedly understands that.

Do you suggest they wait to let more contracts until after you go through your experiment a year or 2 years and then take 2 years to build a plant, or would you rather see them let it now?

I am talking from the standpoint of producing engines and planes.

Mr. PARKINS. I would like to answer that this way:

First of all, it is a little bit out of our line——

Senator MALONE. You live in the United States of America—it is out of my line. I am here. Somebody is going to ask sometime what happened, we do not have it.

Mr. PARKINS. I was going to say that while I don't worry about the production end of the business, I would conclude that if you went ahead on a full-scale program now you would be doing it on a gamble.

It is a question of weighing the urgency of it against the risk.

Senator MALONE. How big a gamble do you think it is? The gamble would be that you never would use it; is it not? Is that the gamble?

Mr. PARKINS. Yes; that we won't be able to use as much titanium as we anticipated, or contemplated, because of running into additional trouble that we don't know about today.

Senator MALONE. Do you think you will run into any that you will not whip?

Mr. PARKINS. I don't know of any, because I don't know what they will be.

Senator MALONE. Do you have any idea that you will run into any problems that you cannot whip into a fast-moving airplane?

Mr. THIELEMANN. It could be.

Senator MALONE. Suggest some.

PROBLEMS IN USE OF TITANIUM AT SUPERSONIC SPEEDS

Mr. THIELEMANN. I think the residual-stress problem in riveting and forking sheet on a fast airplane is going to be a problem. I don't think it has been licked.

Senator MALONE. Is that only on titanium?

Mr. THIELEMANN. Yes. They can do it with stainless steel and aluminum. It will take more work with titanium.

Senator MALONE. I asked you if there was anything you do not think can be whipped.

Mr. THIELEMANN. I can't answer "anything" because I don't know how fast you are going to want to fly planes some day. I think technically about 750° is going to be a top temperature for using titanium for several years to come.

Senator MALONE. What would that mean in speed?

Mr. STREID. Mach 2, which is twice the speed of sound. At Mach 2, which is twice the velocity of sound at high altitude, the inlet temperatures in a jet engine is about 700° Fahrenheit.

Senator MALONE. That is sonic speed?

Mr. STREID. Yes; that is twice sonic speed.

Senator MALONE. That is about 750° Fahrenheit.

Mr. STREID. At higher than Mach 2, which we are working on in many of our advance engine programs now, the inlet temperature is about 1,100° Fahrenheit.

Senator MALONE. Where does titanium fail?

Mr. STREID. Around 700° it starts to show signs of weakness.

Senator MALONE. Around 1,500 miles per hour; is it still good?

Mr. STREID. Only right at the compressor inlet.

Senator MALONE. What speed, would it be practical to estimate now on this matter of heat?

Mr. STREID. This depends on the engine design. I was just volunteering the information.

Senator MALONE. I think that is very good. Would it be a thousand or 1,200 miles per hour?

Mr. STREID. Operating at least in Mach 1, which is less than 750 miles an hour, titanium could be considered for most of the compressor, but when you get to Mach 2 and higher, you have trouble finding any place in the engine where the temperatures are low enough for titanium to be practical.

Senator MALONE. But there is 700 miles or 800 miles between the two. Is not there some place in there—I may be asking something that comes from lack of understanding—but would it be a thousand miles or 1,200, or some place, where it would begin to be problematical whether it would hold up?

Mr. STREID. I would say 1,500 miles an hour there would be many places in the engine where titanium would be practical.

Senator MALONE. Would there be any place in a thousand or 1,200 miles where it would not be practical?

Mr. STREID. Yes, there are places in the engine where it is not practical at even a thousand or 1,200° because of the high temperatures in the engine.

Senator MALONE. Would it be practical at 800 miles.

Mr. STREID. Yes; at 800 miles an hour there are a great many areas in engines where it would be practical.

Senator MALONE. It is practical in many places?

Mr. STREID. No; only in a limited number of places.

Senator MALONE. Does that include the places that would bring it up to 2,500 pound in an engine, still at eight or nine hundred miles an hour?

Mr. PARKINS. We have never considered titanium for the hot end of the engine.

Senator MALONE. That is in any engine?

Mr. PARKINS. That is right.

Senator MALONE. But the places where you are considering it, I asked the question a little awkwardly, where you are considering it, is it good up to a thousand or 1,200 miles an hour?

Mr. PARKINS. Yes.

Senator MALONE. You think it would be good in the places where you are considering it and I asked the question a little awkwardly, Mr. Streid?

Would you answer that question: Where you are considering using titanium it would be good up to ten or twelve hundred miles an hour?

Mr. STREID. The answer is, "Yes".

Senator MALONE. I am just trying to get information for the subcommittee. I am not an expert.

Mr. THIELEMANN. As you go faster there is more of the engine that operates at temperatures over 750 and right now that means that you have less application for titanium.

Senator MALONE. Yes; but where you have been considering it in your testimony up to 2,500 pounds out of the 4,000 or 5,000 pounds it would be good up to ten or twelve hundred miles an hour?

Mr. THIELEMANN. That is correct.

Senator MALONE. In other words, your sonic speed, bomber at a maximum range, that is where you have to have the hotter metal for extra load and fuel. That is the only way you can build a maximum speed, maximum range plane, you agree with that?

Mr. THIELEMANN. It helps you a lot.

Senator MALONE. If someone else had it and you did not, they would just outfly you, would they not?

Mr. THIELEMANN. That is correct.

Senator MALONE. And it is practical to use it for that purpose?

Mr. THIELEMANN. I think so; yes.

Senator MALONE. I think that answers the question for the committee.

Do you have anything further you think would be helpful to us?

Mr. PARKINS. No.

Senator MALONE. Thank you very much. We are very appreciative of your testimony and your coming this distance for this hearing.

Now, Mr. Streid, will you come forward.

You are taking the place of Mr. C. W. LaPierre, who is vice president and general manager of the gas turbine division of the General Electric Co., Cincinnati.

Mr. STREID. That is right.

Senator MALONE. Will you identify yourself for the benefit of the record.

STATEMENT OF DALE D. STREID, REPRESENTING C. W. LAPIERE, VICE PRESIDENT AND GENERAL MANAGER, AIRCRAFT GAS TURBINE DIVISION, GENERAL ELECTRIC CO., CINCINNATI, OHIO

Senator MALONE. You heard questions this morning. It is not necessary to ask you specific questions. Give us the benefit of your experience to the extent you feel free to do so, so that the committee can really add this thing up.

Mr. STREID. My name is Dale D. Streid. I am manager of engineering of the jet engine department at the Evendale plant, General Electric Co. Evendale is a suburb of Cincinnati.

We started about 6 years ago, and have been more and more active since, in the development of titanium for use in jet engines.

We reached the point about 2 years ago where we could put a limited number of parts of titanium into production in one of our jet engines. In one particular model we have increased the number of parts of titanium slowly until at the present time we have 7 parts of 1 engine actually in production in titanium parts.

These are the inner shaft shield; the shroud rings; the breather tube assembly; the bearing housings; some of the seals; some of the vane support rings; and some of the compressor spacer rings.

Beyond these, a critical portion of the engine consisting of disks in the compressor was actually developed and demonstrated by the usual method to show that titanium was satisfactory. However, we have not yet introduced titanium in production quantities for all of these disks because we have discovered only in the last few months that the titanium is not completely reliable in some of them. I guess consistent is a better word. Using the best specifications, the best manufacturing and forging techniques and the best inspection techniques, which we have, we still discover occasionally disks with such poor properties that failure would probably result in time if they were used in the field. This illustrates, I think, one of the most serious problems that we now know of in titanium, the lack of consistency in its properties.

Now, this may be, and probably is, due to the newness of the metal, and due to the relatively short life of the technology of titanium, but, nevertheless, it is a very serious problem because failure of a critical element of an engine like a compressor disk would probably mean loss of airplane and possibly death of the pilot. This is so serious that we don't believe it is good judgment to jeopardize the engine in that way at the present time.

Now, all along, and even today, beyond this particular engine we have an extremely active program of developing titanium for other parts and other uses in this engine and in other engines we have in production.

Senator MALONE. If you have anything you would like to submit as an exhibit for information, you might do that at this time, just as part of our file.

Mr. STREID. I don't believe I have anything, but we are continuing the development of titanium parts.

Actually, the Air Force recognizes the importance of this program enough so that we have a research and development contract for a sub-

stantial amount to develop titanium for uses where it might be utimately put into production.

Just as a matter of interest, I do have some parts here from our development program that you might want to look at. This is a gear blank made out of titanium, not yet completely successful, but one of the things we are working on.

RESEARCH IN TITANIUM FOR ENGINES

Senator MALONE. Why is it not successful?

Mr. STREID. We have not been able to test it. If you examine it closely you will see that the finish on the gear teeth, it is not adequate and so it has not proved to be successful. In any development program you have to start before you end.

Senator MALONE. Do you have any misgivings about its ultimately being practical?

Mr. STREID. No; we think that it is very possible that we will develop some applications where titanium can be used in aircraft gears.

Here is a successful application. This is a bearing housing, almost a direct replacement of steel. Again, that came out first from our development program and was later put into production.

Senator MALONE. What is the ratio of the weight of this metal to the steel, stainless steel, or whatever it is, that was used prior to the development of this housing?

Mr. STREID. Stainless steel has a density of about 0.286 per cubic inch and titanium .163 pounds per cubic inch. Titanium density is about 57 percent of steel.

Senator MALONE. In its usable form?

Mr. STREID. Yes.

Senator MALONE. Of stainless steel?

Mr. STREID. Of stainless steel.

Senator MALONE. Does that run pretty regularly?

Mr. STREID. Very consistent.

Senator MALONE. Now, what is the heat-resistance qualities of steel as compared to the heat-resistance qualities of titanium?

Mr. STREID. That is a very broad question.

Senator MALONE. I know it is.

Mr. STREID. I would say this: You have different kinds of steels, but if you go to the more or less high alloy steels you can get relatively good properties at a 1,000°–1,200° F. If you go to superalloys used turbine buckets, you get strengths up to 1,400° or 1,500° F.

Ordinary steel, carbon steel that we are familiar with, starts to soften or lose its strength properties at 500° F. Now, titanium, the best alloy titanium we have, starts losing its properties at around 700° F. So ordinarily the best titanium alloy is better than low carbon steel on temperature properties, but not as good as some of the heat-resistant steels.

Here is one more part to exhibit. It is a compressor blade, not completely finished, but partly finished, made from titanium.

Again we have spent a lot of time and energy trying to substitute titanium blades for steel blades in a compressor.

Senator MALONE. Do you see any problems in any of these experiments that you will not finally whip; that is to say, given time and laboratory work, that you can make it available?

Mr. STREID. Yes, sir. We see lots of problems. As to whether they ultimately will be whipped depends on how much faith you have in the progress of science. I think you can start in that it is difficult to force or shape titanium and that it is more difficult than steel or aluminum or the common metals;

Second, welding——

Senator MALONE. That goes into the cost of the piece?

Mr. STREID. Yes, well, it is difficult.

Second, on welding, our current experience is that the high alloy titanium products cannot be satisfactorily welded by any known technique. It does not mean that it will not be developed, but when and how, I don't know.

At the present time this very seriously restricts the use of titanium in its high alloy form to parts which are not fabricated.

Senator MALONE. The reason we asked you to come is that the General Electric Co.'s name carries a lot of weight. It is like the engine companies that we have been hearing. When they tackle a problem, we know if they cannot whip it, it is a pretty difficult problem. They are very persistent and they do the job they start out to do, if it is possible.

So we feel that in the engine companies represented and General Electric, we have some top men here.

The progress you are making is very interesting to the subcommittee.

I want you to know that we think we are listening to real expert testimony in this business.

You have heard the testimony of the Secretary, Assistant Secretary of Defense, about the amount of titanium that they have ordered; what is in the cards to be manufactured; how it wends its way from the National Defense Administration to the Office of Defense Mobilization, and the General Services Administration, and I have not found that it takes very long to make that trip.

Now, if it starts at the top, where is the logjam in this thing? Is it the fabrication of the metal; the manufacture of the sponge; the reduction to metal itself? Where is it?

Mr. STREID. At our present rate of use of titanium, we do not see any logjam in availability. In practice, I think it has been adequately described by the former witness, that we order the titanium directly for our uses. That we advise the Department of Air Force and through them the Department of Defense, what our requirements are and what our estimated requirements will be in the future. Nevertheless, the actual procurement of titanium we use is directly by us to the manufacturer and supplier.

Senator MALONE. You are aware that it takes 2 years to build a plant and get it into operation to make the sponge. Do you think that you have 2 years; that is, that you can wait until you know how to use the sponge and then come up to the handle of using the amount that is now being manufactured and then place additional orders for additional plants.

Mr. STREID. Our current belief is that the supply now and in the near future is adequate, unless there is a radical change in the war situation, for example, or national defense requirements, and it looks like it will be adequate in the future for requirements for our production and development.

Senator MALONE. You are telling me now that 35,000 tons of sponge annually—which means about what percentage of metal, about 60 percent?

Mr. STREID. Fifty percent, I would say, or 60 percent.

Senator MALONE. That about 17,500 tons of metal annually is all you can see will ever be used?

Mr. STREID. No, I am saying that that is all that our current production plans contemplate using.

These development programs that we have underway could easily result in requirements for more.

Senator MALONE. How much more?

Mr. STREID. That is a tough question. We made an analysis on one of our new engines which shows a maximum utilization of about 900 pounds of finished titanium.

Senator MALONE. In an engine?

Mr. STREID. In an engine.

Senator MALONE. That would weigh how much?

Mr. STREID. This would be an engine weighing about 3,000 pounds.

Senator MALONE. About a third of it?

Mr. STREID. Yes.

Senator MALONE. It would be titanium?

Mr. STREID. Yes.

Senator MALONE. I have another question there, and I am still groping.

I don't understand your testimony at all at this point. If we are really getting ready for an emergency and we need more planes, are you telling me that all you are going to need is 17,000 pounds of titanium for the frames and the engines; that the National Defense Administration is going to need in the foreseeable future?

Mr. STREID. No, these are two unrelated facts. I said that with the amount of titanium now included in the production engines, the current supply appears to be adequate. The current supply of titanium appears to be adequate.

Senator MALONE. How long will it take you in your opinion to increase the amount of titanium you are using to this 900 pounds?

Mr. STREID. I did not say that we were going to do this. I said that the study indicates that this is possible.

Senator MALONE. What does the study show will be the time element and the rate of increase per year in the percentage in the engine?

Mr. STREID. That is not in the study, but I wanted to give you my opinion on it.

Senator MALONE. You have not given it yet.

Mr. STREID. I want to point out that there are two other factors involved in this situation which must be taken into consideration.

First, I mentioned earlier that as we fly higher and higher speeds, when we get up to Mach 2.0 or twice the velocity of sound, the compressor inlet air is about 700° Rankine.

Titanium is marginal in its application above 750° F. This limits the use of titanium in the engine to a few parts on the outside of the engine and a few parts right at the inlet, or the inlet section of the compressor.

Senator MALONE. That is if you go 1,500 miles an hour you are limited?

Mr. STREID. Yes.

Senator MALONE. You are not going to go that fast, are you?

Mr. STREID. We are not going that fast today. I would like to point out that the engines we are now developing, and the engines that the Air Force is buying for the future, are almost all to be used at speeds up to twice the speed of velocity of sound. We are developing engines to be used at higher than double sonic velocity.

The possibility of using titanium falls off rapidly as you go above twice sonic velocity so that even though, as I say, our studies show quite a few places where titanium might be substituted, this other factor is a compensating factor which indicates that we probably will not substitute a very substantial amount of titanium in these new engines of the future.

Now, at the same time, there has been another development occurring which is the design of lightweight steel parts. Our experience has been that by adequate design of steel parts, or redesign of the present steel parts to a lightweight design, we are able to achieve lightweight construction of almost the same weight as if we had substituted titanium. This also reduces the potential applications where titanium can be substituted.

Senator MALONE. You have just testified that you do not need titanium at all after you go above twice the speed of sound?

Mr. STREID. I said there are only very limited applications for it compared to engines operating below the speed of sound.

Senator MALONE. You have testified that there are lightweight steels that will provide the same range, speed and range, that titanium would provide.

Mr. STREID. There are lightweight steel designs.

Senator MALONE. Why could not you use it then in the 800 mile an hour instead of worrying about titanium at all, if that testimony is true?

Mr. STREID. I would not say it is exactly cheaper, because lightweight steel designs are expensive.

Senator MALONE. It would not cost as much as titanium costs now.

Mr. STREID. That is possibly true, but the price of titanium will come down.

Senator MALONE. Why do you need titanium at all if you can use these parts that will substitute for it and go the same range and same distance? I am talking about the same speed and range at 800 miles an hour?

Mr. STREID. I believe that there will always be some parts and some applications in an engine where titanium will be the best metal to use.

Senator MALONE. What would they be if you can do this thing you have just testified to?

Mr. STREID. There are brackets on the outside of the engine, there are vanes in the inlet section of the engine; there is the inlet spider, and there is the support of the front bearing that may always be ideal applications for titanium. Also bearing housings may for a long time to come be an ideal application for titanium.

Senator MALONE. There are places where they would get pretty warm if you get up to 1,500 miles an hour.

Mr. STREID. Yes; although even at that speed we expect many things will have to be cooled. The oil may have to be cooled instead of heated for this kind of application.

Senator MALONE. Did I understand you to say that these new light steel alloys can be made as strong for the same weight?

Mr. STREID. I said it is possible to use light weight steel construction and have the same weight as though titanium construction were used.

Senator MALONE. Why worry about titanium at all?

Mr. STREID. Because we are talking of some specific parts.

Senator MALONE. Why would you use titanium in those certain parts? You know you can use steel in any part, do you not? If it is as light and as strong, it does not make sense that you are worrying about it.

Mr. STREID. This is not true of all parts. It is our current opinion that lightweight steel construction of a compressor disk will give us a total overall weight as light as though the disk were made of titanium.

Senator MALONE. The same strength?

Mr. STREID. Satisfactory strength for the application.

Senator MALONE. Well, that still does not answer the question.

If it is not as light then you are not saving as much weight as you could with the use of titanium, are you?

Mr. STREID. The entire construction is as light. If you should substitute titanium directly for the steel, if this were possible, then the titanium part would still be lighter again.

Senator MALONE. Then you are not getting the lighest plane that you can build with the same capabilities, unless you use it; are you?

Mr. STREID. Yes; I think you are.

Senator MALONE. Did I understand you to say in the beginning, that the new steel alloys to be substituted would have the same strength for the weight?

Mr. STREID. Yes.

Senator MALONE. Then you just got through saying that there would still be something desired if you used the steel, that titanium would be lighter.

Mr. STREID. There are some other applications and some other parts in the engine where the use of titanium will result in a lighter weight engine than if steel were used throughout.

Senator MALONE. Your statement is not correct if you will let it stand. It is corrected now.

Mr. STREID. Yes.

Senator MALONE. In other words, there are certain parts that will be lighter with the same strength than you can possibly make of any kind of steel alloys?

Mr. STREID. That is true.

Senator MALONE. If you reached that point, how much titanium would you put in a 3,000-pound engine? Instead of 900 pounds of titanium, how much would you put into a 3,000-pound engine?

Mr. STREID. One hundred pounds of titanium.

Senator MALONE. All other parts could be made of the steel alloys and have the same strength with the same weight?

Mr. STREID. Yes.

Senator MALONE. I understand you now, but it still does not make much sense to me, and I think it is on account of my lack of understanding.

Mr. STREID. As I say, there are two developments that have led to this situation. One is the further development of the art of lightweight design in steel. The other is the high-temperature problem introduced by the very high-speed flights.

Senator MALONE. I understand all that, that you use steel where the temperature would be above the practical use of titanium.

Mr. STREID. Yes.

Senator MALONE. But when you say to me that in that same part the steel can be designed for the same strength and same weight in one part where it could not in another, I cannot coordinate it.

Would you name a part to me in the engine that you could have the same strength with the same weight, but still would come under the 100 pounds titanium instead of the 800 pounds?

You use titanium instead of stainless steel, at the same time you could have the same weight and the same strength and you know it is higher heat resistant.

Why would you use a hundred pounds?

Mr. STREID. This bearing housing is a good example.

Senator MALONE. If you can make one just as light and strong enough, why would you make it out of titanium?

Mr. STREID. It would be lighter than if you used steel for this part.

Senator MALONE. Why?

Mr. STREID. Because of the density.

Senator MALONE. You can make it thinner with steel.

Mr. STREID. This is true except that you reach a point where whether you use steel or titanium or anything else, there is a physical limit as to how thin you can make it and still manufacture it and still measure it and still have it reliable for all ordinary handling and use.

Senator MALONE. You have testified today that if the light steel alloys are carried to an ultimate conclusion—it certainly should be if you can use it—it would be cheaper than titanium, fooling with it at all—instead of 900 pounds you are using 100 pounds, which is one-ninth—all you need is 3 percent instead of 30 percent.

Mr. STREID. Yes.

Senator MALONE. That is all you need.

Mr. STREID. At the present time, that is what it looks like.

Senator MALONE. Then what are we worrying about titanium for?

Let me ask you another question: If you are going to get it down to 100 pounds, 3 percent of the engine, how much weight will you save, or how much would those same parts weigh if you made them of steel?

Mr. STREID. About 150 pounds.

Senator MALONE. In other words, you would save 50 pounds in the whole engine by using titanium?

Mr. STREID. Yes.

Senator MALONE. You are simplifying this whole thing. If that is all you are going to save in an engine, 50 pounds, I do not think we have anything to worry about. You are not worrying about titanium at all.

Mr. STREID. No, except that I want to point out that there is this potential 300-pound savings which we think is very much worth working on and trying to develop and may be achieved some day.

Senator MALONE. In other words, 10 to 1, or 6 to 1, with the frame and all?

Mr. STREID. No, I am speaking of the total 900 pounds which might be titanium, and I am saying that it is worth working on titanium development and doing the research and development necessary, because of the fact that some of this additional saving may be possible some day even though at the present time it does not appear possible.

Senator MALONE. Maybe I misunderstood you. If the titanium works out and the experiments are successful, which you think they will be, then you can save the 900 pounds over the steel, even these new alloys?

Mr. STREID. That is right; we can use about 900 pounds.

Senator MALONE. I misunderstood you completely. I will have to read your testimony.

Mr. STREID. It is not clear how we can do this and we should not count on it at the present time. Like any other research, you have certain possibilities that you work on and only when you achieve them do you take credit for them.

Senator MALONE. Do you have any real doubt that you will be successful?

Mr. STREID. Yes, I have. As with any research program, I don't think that you should say that we are going to be successful. I think we should count only on what we know for sure and hope for the rest.

Senator MALONE. We all understand that. I have been in one phase of the engineering business for 30 years. You do not put in a bridge until you have had your tests and know your safety factor and other things. But if you have a reasonable idea when you build the next bridge that the tests will stand up, then you have a future to look forward to.

Now, if these tests, which Mr. Hurley and Mr. Parkins talked about, do turn out all right, then there is a possibility of saving this 900 pounds instead of the 100 pounds.

Mr. STREID. Yes.

Senator MALONE. Do you know what I understood you to say? That there was no part in there except the 100 pounds that could not be displaced by the new steel lightweight alloys with the same strength and the same weight.

I think you said that. You did not mean that, did you, or did you?

Mr. STREID. I say that is true at the present time.

Senator MALONE. If you stop at the present time, I guess we would not have had guided missiles for maximum range and we would not—if we stopped in the war, the First World War, we would have been tapping it out with the Morse code on the radio. We did not stop, did we?

Mr. STREID. No, that is right. I am not recommending that we stop research on titanium. I think we should proceed.

Senator MALONE. You are not telling me now that you have any idea that you will not whip any of these problems?

Mr. STREID. I think we are going to whip them, but I can't say which, when, or how.

Senator MALONE. But you are making progress and you think you are going to do it?

Mr. STREID. Yes.

Senator MALONE. But your testimony first was that 100 pounds is all that you could not replace with the lighter steel alloys and have

the same strength and the same weight. If I had stopped questioning you then I would have still understood that.

I understand you now to say that at the moment you have to use the steel, that 100 pounds is all that you can save today?

Mr. STREID. Yes.

Senator MALONE. You could not save that a year ago, could you?

Mr. STREID. No.

Senator MALONE. You have made a little progress.

Mr. STREID. We have made a great deal of progress.

Senator MALONE. At first you could not save any.

Mr. STREID. That is right. Five years ago we could save none.

Senator MALONE. I am glad to have your testimony. It will be returned to you and I hope you will make it so that the chairman can understand it.

Mr. STREID. I will try.

Senator MALONE. That is one principle the chairman goes on. In order to explain anything to anybody else, you have to understand it yourself. If I am going to explain this to the committee, I have to understand it.

Now, Mr. Hans Stauffer is here, of the Stauffer Chemical Co.

Mr. Stauffer, I have asked you to come here because you make a very important product that goes into the manufacture of sponge for this titanium metal. You are located in Henderson, Nev.

STATEMENT OF HANS STAUFFER, STAUFFER CHEMICAL CO., NEW YORK, N. Y.

Mr. STAUFFER. Henderson, Nev., and Niagara Falls, N. Y.

Senator MALONE. Will you identify yourself for the record and give us an idea of the importance of this product that you manufacture that goes into the manufacture of titanium sponge and what are the criteria of your being able to manufacture it; what the power element is, and how you are getting along—the progress in the manufacture of it.

MANUFACTURE OF TITANIUM TETRACHLORIDE

Mr. STAUFFER. I am president of Stauffer Chemical Co., manufacturer of a number of industrial and agricultural chemicals. Senator, the product we make that is used in the production of titanium is titanium tetrachloride. We have produced the compound since 1917. Chlorine is an important raw material for the production of titanium tetrachloride. It takes a little over 4 pounds of titanium tetrachloride to make 1 pound of titanium sponge. Roughly 1 pound of chlorine is required for each pound of this chloride; which means that each pound of sponge involves the use of 4 pounds of chlorine.

It comes down again to the matter of production of chlorine which depends on the availability of cheap power and that is very, very important. We have been at work on reducing the cost of making titanium tetrachloride which, in turn, depends entirely on the type of raw material you use. Canadian slag or ilmenite would be less costly as raw materials than the material we have been using.

We have made regular progress in developing a new process for making titanium tetrachloride more cheaply, and, what is equally

important, for making titanium tetrachloride of a high purity so that your problem in making metal is simplified because you must have a metal of very high purity; and that depends upon the purity of the titanium tetrachloride.

Senator MALONE. What are you using as raw material in Henderson?

Mr. STAUFFER. We are using power and salt to make chlorine.

Senator MALONE. They use the rutile.

Mr. STAUFFER. We don't make titanium tetrachloride at Henderson. We are selling chlorine to Titanium Metals Corp. who in turn make their own titanium chloride.

In Niagara Falls we are making titanium tetrachloride and we are carrying on a lot of research work on the tetrachloride process, so as to be able to use any type of raw material, including Canadian slag or ilmenite.

Senator MALONE. Is there a difference in the process in the raw materials you use, that is, in the rutile or ilmenite?

Mr. STAUFFER. The process is essentially the same regardless of which raw material is used; but the cheaper raw materials require a different type of equipment. It is a matter of cost of production. Obviously, if you can use titanium slag, the cost of production will be lower.

What is equally important, titanium slag is available on the North American continent in quantity; whereas rutile to some extent has to be imported.

Senator MALONE. Where do we get the rutile?

Mr. STAUFFER. There is some supplied from Australia.

Senator MALONE. Why do we use the raw material from Australia, knowing full well this will not be available if war started and when titanium slag will be cheaper and available in this country?

Mr. STAUFFER. That is a matter of technological improvements. It is easier to use rutile than it is to use titanium slag.

Up to a short time ago titanium slag was not available.

Senator MALONE. I guess it would have been available if there had been a demand for it, would it not?

Mr. STAUFFER. I guess so, but you must not forget your big use for titanium slag or rutile or ilmenite is for the production of titanium oxide pigment.

Senator MALONE. We have testimony from Kennecott Copper Corp., in their plant in southern Canada, that they are producing a 70 percent titanium slag and a pig iron.

Both would be feasible if they could both be used. Titanium slag has not so far been in demand for the manufacture of titanium.

Mr. STAUFFER. It is a more difficult raw material to handle than rutile.

Senator MALONE. But less expensive.

Mr. STAUFFER. It is less expensive.

Senator MALONE. I understand that as a result of these hearings that the Bureau of Mines in Boulder City now are experimenting with the best method of changing over to ilmenite, so I presume it will be changed on account of the national defense angle.

Mr. STAUFFER. That is right. We feel quite confident that we can use titanium slag from Canada in the production of titanium chloride.

Senator MALONE. That will be available in wartime as well as peacetime?

Mr. STAUFFER. That is right.

Senator MALONE. And plenty of it.

Mr. STAUFFER. As far as titanium metal production is concerned, I would say unlimited quantities.

Senator MALONE. Well, they say there is a supply for a hundred years anyway. We will not look much further ahead than that.

Do you have an idea of what power means in the production of your product? That is to say, cost of power and its availability?

Mr. STAUFFER. It is a very important factor. Outside of salt, it is the only other important factor in the production of chloride.

Senator MALONE. What number of kilowatt-hours per unit of production is necessary?

Mr. STAUFFER. We are consuming at the present time in Henderson about 250 million kilowatt-hours.

Senator MALONE. In the manufacture of chlorine?

Mr. STAUFFER. In the manufacture of chlorine.

Senator MALONE. You are aware since that Titanium Metals Corp. is up now to its 10 tons per day that they are up for an additional contract of 15 tons per day; is that right?

Mr. STAUFFER. That is right.

Senator MALONE. What would that mean in additional kilowatt-hours that you would need for chlorine, one and a half times as much as you are now using in addition?

Mr. STAUFFER. It would be a substantial increase. I can't tell you how much more.

Senator MALONE. Two hundred fifty million kilowatt-hours annually for the amount of chlorine used in 10 tons of titanium production, you would need one and a half times the amount you are now using if they went up to 25 tons a day?

Mr. STAUFFER. Some of the chlorine goes into some other production.

Senator MALONE. Do you ship some elsewhere?

Mr. STAUFFER. We ship some to California.

Senator MALONE. I know this is a technical thing that will take some estimating. When your testimony is returned to you for correction and completion, will you go ahead with the amount of chlorine that you are moving for the titanium alone or for the national defense industry in Henderson, and about what the increase would be, what increase would be necessary in kilowatt-hours for a 15-ton-per-day increase in the manufacture of titanium.

Mr. STAUFFER. It takes about 4 tons of chlorine to make 1 ton of titanium metal.

Senator MALONE. It takes about 40 tons a day?

Mr. STAUFFER. Yes.

Senator MALONE. How many kilowatt-hours does it take to manufacture 40 tons?

Mr. STAUFFER. I would say about 40 million kilowatts for 40 tons of chlorine. An additional 15 tons of sponge would require an additional 60 tons of chlorine — calling for an additional 60 million kilowatts.

Senator MALONE. Do you have any further information that will help the committee?

Mr. STAUFFER. None whatsoever except it is important to improve the technique of making titanium tetrachloride in order to get it all fast.

Senator MALONE. Any improvement you make results in saving overall cost?

Mr. STAUFFER. It should, because you are talking of 4 tons of titanium tetrachloride for each ton of titanium metal, so every 5 or 10 cents amounts to a considerable amount of money.

Senator MALONE. You do manufacture other material out there for defense purposes, too, do you not? I do not want you to say anything that is classified, but you do have other contracts?

Mr. STAUFFER. Of course, our big items are insecticides, items like DDT, and benzenehexachloride; and chlorinated compounds such as carbon tetrachloride which is used in the manufacture of refrigerants like Freon.

Senator MALONE. Your company out there does have other defense contracts?

Mr. STAUFFER. They do.

Senator MALONE. Mr. Stauffer, I am awfully glad that you came down from New York to be with us today and offer your testimony. Your testimony will be returned to you.

Mr. STAUFFER. Thank you, Senator.

Senator MALONE. Now, we have Dr. Arthur Flemming, Director of the Office of Defense Mobilization.

Doctor, maybe we can hear you better if you come over here and be opposite the reporter.

Doctor, you have been with us before about three times. We always fall back on you because you seem to be the one that the ball finally bounces up against and all the troubles are yours eventually.

You have heard the testimony today. I appreciate your being here. If you will identify yourself for the record and give us some idea of how you think we could meet the requirements for national defense when a lag develops, as it does develop, realizing that I am correct in the idea of the theory that there is a 2-year lag after you receive the order, we will appreciate it.

STATEMENT OF DR. ARTHUR FLEMMING, DIRECTOR, OFFICE OF DEFENSE MOBILIZATION, WASHINGTON, D. C.

Dr. FLEMMING. Mr. Chairman, my name is Arthur S. Flemming, Director of the Office of Defense Mobilization.

On the basis of information that has been presented to me and developed here this morning, I would say that titanium is a metal that possesses laboratory proven value for military use.

There does not seem to be any argument about it.

However, at the moment there is a good deal of improvement that can and should be made, as far as end use know-how is concerned.

Apparently those who are working with these problems have not adopted a defeatist attitude regarding their solution, but have the feeling that in someway the know-how can be supplied.

Until someone proves that the know-how cannot be supplied, the Office of Defense Mobilization has an obligation from the standpoint of national security to step up the availability of sponge, both by increasing productive capacity, and by increasing our inventory.

This is what we have been doing. This is what we will continue to do.

Also, it seems to me that the Government has an obligation to help provide the production and end use know-how through research and development contracts and other ways.

My understanding is that the Department of Defense, particularly the Air Force, has been moving definitely in that direction.

As I see it, you can sum up the whole situation very briefly by saying that the Government can, if it so desires, in this case it would be ODM, sit on expansion proposals while technological problems are being solved, and then when the problems are solved run the risk of not having the sponge available, or it can move forward with expansion programs and run the risk that the technological problems will not be solved and that we will have on our hands a surplus of sponge.

As far as I am concerned, I choose the latter course and choose to run that kind of risk.

Now, you recognize, of course, as we do, that the building up of inventories, will involve a rather large expenditure of money on the part of the Government. And, the time may come, Mr. Chairman, when we will need some help on the Hill in connection with funds for that purpose.

As you know, I have tried to become acquainted with this problem. Everything that I have heard, both at the hearings you have conducted, and the information that has been presented to me by our own advisory committee, leads me to believe that this is a situation where in the interest of developing something which apparently will be very important to national defense, we should be willing to take some calculated risks. And, as far as we are concerned, we will take them.

Senator MALONE. You heard the testimony today of the Curtiss-Wright Corp. and others, that they think that this program is going to be, that is, that the use of this metal is going to be whipped into shape in a fairly reasonable time; increased within a year; that it could have been increased this year if they had gone ahead.

Now, they are a year behind; they could be another year behind if they are not given the go ahead signal. If it is there will be a great percentage, much greater percentage of titanium used each year until you reach up to 20 percent or 25 percent of titanium in an engine and the plane makers testified 25 to 40 percent, that is in the frame.

Nothing like that is in use now and if it were it is obvious you would not have enough titanium.

If we do not have confidence that they can do what they say they will do, like Douglas Aircraft, Lockheed, Hurly of Curtiss-Wright, and the rest of the potential users, then the pressure would be off.

But these men are in the business. As chairman of the committee, speaking only for the chairman, I thought we knew what they were talking about and if they did we would be very short of titanium in a reasonable time if it takes 2 years to build a plant and get into production, unless the sights were raised on this 35,000 tons annually.

You heard the Secretary this morning say that is all the titanium you need. I thought that this committee might fill a need in there that maybe we could help sell a bill of goods to the full committee and providing this is really necessary for national defense.

What do you have to say to that? Would you hold it now until they whip it, or would you hold it until they raise it?

STEPS TAKEN TO INCREASE PRODUCTION OF TITANIUM SPONGE

Dr. FLEMMING. As far as we are concerned, we will continue to do those things that it is necessary to do to increase productive capacity of sponge. As you know, for sometime now, the General Services Administration has not been instructed to work against any particular ceiling. They simply have been told that when they reach a particular point in negotiating proposed contracts, they should come over with the proposal and discuss it with us.

I think that the various proposals which may be suggested should be handled on just that basis.

We should take each one of them as they come along. If it is a proposal that seems to provide the Government with additional sponge capacity, meeting high specifications, I don't think in the light of everything that has been presented here, that we should fool around with our specifications, because we certainly don't want to get into the position of stockpiling or putting into inventory sponge that will become obsolete and that no one can use.

Senator MALONE. Do you believe that the necessary specifications now are being met?

Dr. FLEMMING. It is my understanding that it is possible to get sponge that meets the specifications that the users are calling for at the present time.

Senator MALONE. Now, you heard the testimony that added up to around 150,000 tons annually that would be necessary for the national-defense program providing proper steps were taken and proper progress was made in the use of the metal and it did meet specifications which it now does.

What do you think this ceiling ought to be, instead of 35,000 tons that is now ordered?

Dr. FLEMMING. Senator Malone, I don't think we ought to be really talking in terms of ceilings. I think we ought to take each proposal that is presented to us and look at it in the light of the best information that the Department of Defense can give us right at that particular time.

After we get that information, then we have to apply a judgment factor; in other words, let me put it this way—let us assume that the Department of Defense says, "Well, there are some technological problems that have developed and we don't think that from our point of view we ought to step up our requirement right at this time. We think we ought to wait a little while and see what happens on these technological problems."

As I see it, it might be very well at such a point and it would be my disposition at such a point to say, "Well, we think that these technological problems are going to be solved. We don't think that when they are solved the Government should be in the position of not having sufficient sponge capacity to take care of the demand. Therefore, we are going to take a calculated risk and go a little bit ahead of what seems to be the requirement before these technological problems are solved."

That is going to be our approach to it.

Senator MALONE. Can you in your position go ahead of what has been ordered by the National Defense Administration, Doctor?

Dr. FLEMMING. In the first place, our responsibility, Senator, is to take the requirements information that comes from Defense, and take requirements information on the nonmilitary side—I am talking now of any requirements information that comes to us from Commerce, Interior, and other agencies that advise us—bring it all together, balance it against the available supply, and determine what the gaps are, or are likely to be, and then decide whether or not we should authorize further expansion.

That is our ultimate responsibility. We can't pass the buck to anyone else.

I think we have a perfect illustration of it right now. I think Defense properly says, "Well, we have been told there are some technological problems here which have slowed us up on giving you a firm figure as of the present time."

We recognize the existence of those technological problems. But, we have to say, "Well, is there a chance that those problems will be solved?"

All of the testimony that I have heard from others and have heard here, indicates that there is a very good chance of their being solved.

Therefore, we have to look just a little further ahead and say we are not going to let the Government get in a position where it is caught short on productive capacity.

Senator MALONE. We still come out at the same place. We know if the plans work out that the 35,000 tons is not enough annually.

I will ask a question in preface to the next one. Are you rationing this material at all? Is there any limitation for civilian use?

Dr. FLEMMING. There is a control order under which the mill products producers are not required to accept rated orders for more than 90 percent of scheduled production. Thus they now may devote at least 10 percent of their present capacity to production of nonmilitary items, and more if the volume of rated orders does not take up the 90 percent of capacity reserved for such purpose.

As far as sponge is concerned, I think we are in a position where if producers of nonmilitary items came in and wanted to utilize some of the sponge which has already gone into our inventory, we would make it available to them.

Let me make it clear, I don't feel we are working against any artificial ceiling of 35,000 tons per year.

As you know, the capacity is not up to 35,000 yet.

Senator MALONE. What is it up to for contracts that have been let?

Dr. FLEMMING. It is 22,500 at the moment.

Senator MALONE. Would you submit as part of your testimony the date of letting each contract beginning in the beginning and just have a table which would show the progress?

Dr. FLEMMING. I will ask General Services Administration to supply that because they enter into the contracts.

(The material referred to follows:)

GENERAL SERVICES ADMINISTRATION,
EMERGENCY PROCUREMENT SERVICE,
Washington D. C., December 15, 1954.

Hon. GEORGE W. MALONE,
United States Senate, Washington, D. C.

DEAR SENATOR MALONE: During the titanium hearing on December 8, you requested information as to the dates of the various titanium-expansion contracts. This information follows:

Contract No.	Contractor	Effective date
GS-OOP(D)-12047	Titanium Metals Corporation of America	Aug. 1, 1951
DMP-6	E. I. du Pont de Nemours & Co	July 24, 1952
DMP-75	Cramet, Inc	July 31, 1953
DMP-99	The Dow Chemical Co	July 8, 1954
DMP-100	Union Carbide & Carbon Corp	Sept 14, 1954

If we can be of further assistance, please call upon us.

Very truly yours,

A. J. WALSH, *Commissioner.*

At the moment it is 22,500. There is a proposal pending which would step that up by an additional 7,200 tons.

Mr. Chairman, if those proposals met all of the specifications that we should meet, my own inclination would be to say to General Services Administration, "Go ahead and work it out."

Senator MALONE. Even if they order more than 35,000 tons?

Dr. FLEMMING. Yes. There is nothing magic about that 35,000 tons.

Senator MALONE. You understand that the testimony before the committee from the chemical industry, and possibly others, is that they need this material; they could not start to use it unless they knew it was available. They could not take it out of your stockpile because they did not need it this year because if they started manufacture there would be a lot of money lost in stopping it.

Dr. FLEMMING. That is right.

Senator MALONE. Now, what would you propose so that the civilian industry could go right ahead, even though the National Defense Department were a little fainthearted and wanted to stay with the 35,000?

Dr. FLEMMING. Well, Mr. Chairman, I am sure Secretary Lewis will bear this out: when we are facing a problem of this kind for example, the question of whether we should approve some of these pending proposals, we deal with the Department of Defense on a continuous basis, on a day-by-day basis.

I know that Mr. Pike and his associates, as well as Secretary Wilson and Secretary Anderson, would be perfectly willing to sit down and evaluate a particular proposal in the light of information available at the time, and give us a recommendation.

I have a mechanism for getting that so we don't get stuck with arbitrary figures.

We have a Defense Mobilization Board that is made up of seven Cabinet officers.

When I get a proposal of this kind I put it before them, with all the facts, and ask their advice.

I would, of course, have to assume responsibility for the decision.

Senator MALONE. You could put a little heat on if necessary.

Dr. FLEMMING. It is always possible to get them to take a look at the specific problem that is before us in the light of all the facts available. I think it is a much better way for us to proceed than for us to work against what are bound to be arbitrary ceilings at best. Let us keep reexamining the facts each time we have a proposal before us. You have heard this testimony and you have heard some this morning that the increase in the use will be very fast as they whip these particular problems. You heard Mr. Hurley's testimony that he is ready now and has been ready for a year to make certain engine parts with titanium and would try to increase the number, just so long as he knows he will have enough titanium to keep the parts in the engine; that is, he won't have to take them out because of a lack of titanium.

Senator MALONE. Maybe there is a slip in there some place, that some of these boys have not been turned loose.

Dr. FLEMMING. I am going to do everything I can to make sure that the Government stays at least one step ahead of consumption.

Senator MALONE. The civilian industry wants it; as a matter of fact, the commercial plane manufacturers want it, even at the present price. Now we get into a round robin there, where, of course, no one can start manufacturing a plane for civilian use and using this material, knowing that at any moment you are liable to put the lid on so that it will not be available to them. How are we going to handle that part of it?

Dr. FLEMMING. Mr. Harris points out that the production of the civilian-type aircraft will be rated orders, just as the military, because of their possible relationship between those aircraft and our defense.

Senator MALONE. You mean drafting them into use in case of war?

Dr. FLEMMING. Yes. But let us assume for the sake of argument that was not the case. I see no reason why it is not possible now in the light of the contracts that have already been entered into for the production of sponge and in the light of what seems to be around the corner, to project what the production is going to be, say a year from now. As you have indicated, the assumption is that during 1955 it will be about 10,000 tons.

When it is determined what production it will be in 1956 and 1957, we can then sit down with the Department of Defense and come up with and give the industry some indication of the amount that could be made available for nonmilitary purposes, of course always subject to the qualification that if some developments take place in the military that step up their requirement, that will be over-riding. In other words, we cannot give the commercial user any guarantee. We can just give him our best judgment as of a particular time. I do not see how we can go further.

Senator MALONE. Now you have 22,500 tons on order?

Dr. FLEMMING. That is right.

Senator MALONE. How long would it be right now until there will be 22,500 tons produced in 1 year under your present program?

Dr. FLEMMING. It will be sometime in 1957.

Senator MALONE. Early or late 1957?

Dr. FLEMMING. About the middle.

Senator MALONE. About 2 years ahead?

Dr. FLEMMING. Yes. The lead time, as I understand, is 18 to 24 months.

Senator MALONE. You heard the testimony here today that they think they will whip these problems in 2 years if they are just turned loose now?

Dr. FLEMMING. That is right.

Senator MALONE. Which they have not been, some of them?

Dr. FLEMMING. That, Mr. Chairman, is why I say I will continue to look with real favor on proposals for stepping up this capacity.

Senator MALONE. We have lost 1 year at least with 1 engine company because they have not said they could go ahead with these parts under 1 contract. Now if we lose another year, and of course if we hold that back, then you will never need them.

Dr. FLEMMING. As you know, we have not been holding back on entering into contracts.

Senator MALONE. No; you are not. You have done everything that is necessary.

Dr. FLEMMING. We will continue to follow that policy.

Senator MALONE. I thought that you had to have the word there before you could give it to the GSA.

Dr. FLEMMING. It is not an order in the sense in which we normally use that term. When we establish what our mobilization gaps are in any area, we try to get the best requirement information we can. Obviously, we have to depend on the Department of Defense for the military requirement. I know something about their problems—in the development of requirements data in the first instance, and keeping them current in the second instance.

I would like to say this: Overall I do not know of any time in the history of mobilization planning when we have had better success in getting good requirement figures from the Department of Defense than we have right now. The fact they may be a little conservative at times is a rather wholesome thing because, as you know, there have been times when Defense has been anything but conservative; and that in turn has had a bad effect on the economy as a whole.

Senator MALONE. I do not think they are conservative now. They are just conservative in some places, and maybe that is not a good place to be conservative.

Dr. FLEMMING. When they identify the reason for holding down a requirements figure as being that of having difficulty with the material from a technological point of view, then it seems to me it is our responsibility not to take just blindly a statement like that and use it as a basis for doing nothing. We have to get out and look around and say, "Look, is there a chance of licking these technological problems?" If there is, then as I see it the Government should take a calculated risk and go ahead with its plans for the expansion of productive capacity. That is what we intend to do.

Senator MALONE. You heard Mr. Parkins and Mr. Hurley. Neither one of them talked about any problem they are not going to whip in the next 2 years. You cannot build a plant in less than 2 years.

Dr. FLEMMING. All right, Mr. Chairman. You and I are not in disagreement; we are in agreement.

Senator MALONE. Isn't this metal about the only thing that is rationed now, or controlled?

Dr. FLEMMING. As I say, it is not quite accurate to put it in that category, although that is about the situation.

Senator MALONE. The objective of all critical materials, it seems to the Chairman, is to arrive at the point where the going conservative capacity plus the stockpile equals any estimated use during any war that you are likely to have.

Dr. FLEMMING. That is right.

Senator MALONE. There is a further objective, and that is when the civilian industry uses about the amount that you are likely to need in national defense. It is no longer critical, generally speaking, because when you are in a war you have it.

Dr. FLEMMING. You mean you can go out and divert it over into defense?

Senator MALONE. Yes.

Dr. FLEMMING. Mr. Chairman, that is exactly the policy that we follow right straight across the board. When we are at the place where we have a domestic capacity plus a stockpile that will take care of our needs, then we are all right. But until we reach that point, we have some problems. As you also know, we are just as much interested in keeping the domestic capacity at the right level as we are in the stockpile.

Senator MALONE. You do know that the civilian interests would use a lot of this if they could get it, I guess. So let us get back on this thing. The forerunner of the hearing in Henderson was the rumor that we had much more titanium than we needed. In that hearing we heard a Colonel MacDonald who told me in the record, not once but 4 or 5 times, that they had written to the users and they were using the users' estimate of what they were going to need to base contracts on. I do not know. Maybe sometimes I am a little slow on the uptake, but it took me a half hour to realize that what they were doing was letting contracts for a certain amount of engines in planes with the titanium that they are now using. Then they would write out and ask the fellow how much titanium they were going to use, and they would get back their own figures. Somehow or another we had to break out of that corral. I thought we would this morning, but we have not yet.

They are not going to order any more than the contractors say they are going to use, and the contractors cannot say they are going to use any more, realizing that it is a 2-year deal after they whip this thing before you can possibly get into production, if a contract is let now.

Dr. FLEMMING. Mr. Chairman, I do not want to be speaking for Defense on this question except from one point of view, based on my own experience in dealing with them in problems of this kind. I am sure they are not going to permit this program or any other program to get caught on dead center.

Senator MALONE. They have already. They will have it on dead center. That is the reason for this meeting.

Dr. FLEMMING. Well, Mr. Chairman, I think we have to go back to the fact that as proposals for increasing productive capacity have come in they have been approved and they are underway. I think you and I are in complete agreement. Let me take the testimony of General Electric. As I understand the testimony——

Senator MALONE. I have some new testimony there. They do not need titanium at all.

Dr. FLEMMING. As I understood it, listening here this morning, at the present time General Electric says that with what has been proved out, they could use 100 pounds per engine. Also, the witness indicated that it is conceivable that if certain problems are licked, they could go up to 900 pounds per engine.

Senator MALONE. But they do not need it. All they need is steel. His testimony was this: that they could use 900 pounds of titanium per engine, which is one-third titanium, but he would use only 100 pounds.

Dr. FLEMMING. I do not know whether my interpretation of that is correct or not, but let us assume it is. At the present time they can use 100 pounds per engine, but if some of these technological problems are solved, they can use 900 pounds.

Senator MALONE. They testified they did not need that 800 pounds.

Dr. FLEMMING. Let me assume hypothetical testimony along that line, that someone alleges that now we can use 100 pounds; that if we lick these technological problems, maybe we can get up to 900 pounds. I am sure Defense will agree with me in saying that in an area of this kind where we are thinking in terms of what our requirements would be in the event of all-out war, we should not rely on that 100-pound figure. You certainly cannot stay with 100 pounds, or you are bound to be caught short. If you go all the way to 900 pounds, maybe you are taking a calculated risk. As I see it in the kind of world in which we are living at the present time, you have to take this calculated risk in these critical materials areas.

Personally, unless I had technological information which would indicate to me that I should not rely on 900 pounds, that I should rely on 750 or 600, I would say that we should move forward with our program on the basis of the fact that we are going to need the 900 pounds.

Senator MALONE. Dr. Flemming, you are a great comfort to me. Here is another thing that you will agree with. I would like to know if you do. When you put 900 pounds of it, practically, in 1 engine, you have to look toward remaking all the engines you have off the ground in the place and putting 900 pounds in it to do the same job, don't you?

Dr. FLEMMING. That may be.

Senator MALONE. Now if you are going ahead making these planes that go six or seven hundred miles an hour and you are not making the planes now that can go the maximum distance, the maximum speed without refueling, but you are looking forward to that. So when you get them you have to make all the rest of them. What are you going to make them out of, go back to steel?

Dr. FLEMMING. Mr. Chairman, I would like to go back to the statement I made in the beginning which reflects my philosophy. There are some questions about future requirements that hinge on certain technological problems. Apparently the evidence on the part of those who are technically competent is optimistic. They believe they can solve these problems. Now I feel, then, that we should proceed on that assumption, until such time as someone comes in and proves that the problem cannot be solved. As I gather from the testimony here and other testimony, no one has undertaken that kind of assignment up to the present time.

Senator MALONE. The only thing is that I am going to ask the General Electric man in just a few minutes what kind of steel this is and who makes it because I think they have been holding out on us.

Now the Second World War and then in Korea we killed a lot of pilots out there because the planes were not as good as the enemy's, and that is something that I do not like to look forward to. So we either are looking forward to having trouble with a certain nation or we are scaring our people unnecessarily. If we are letting loose these statements for the benefit of economists, of war coming at any moment, in order to get money, we had better quit. If we believe it, we had better start manufacturing planes and we had better start getting material.

Now if General Electric can make them without it, let them have all the contracts and let them go. If they can't, we had better get to the bottom of that one, which I intend to do.

Now we are wasting our time if we do not need this metal, but we are going in a roundrobin the way it is. I found out now that you do not need anything from the Secretary of the Air. You can get it from your boss in the committee.

Dr. FLEMMING. We do need their requirements information.

Senator MALONE. You are not going to get it.

Dr. FLEMMING. We are going to get requirement information, all right. I am sure that it will be information that will shift and will be adjusted from time to time. Secretary Lewis and people in a comparable position to him have not only the problem of technological development, but they have the fact that planes change from time to time. When planes change, requirements change. Consequently, we expect them to keep us up to date.

Senator MALONE. I am probably not up to date. I certainly do not understand the testimony. I understand yours, that you are going to go right along and take a chance whenever you are given a place to put your feet.

Dr. FLEMMING. Right.

Senator MALONE. I appreciate that. You have made a good witness, as usual. The fact remains that you cannot get up to 22,000 tons of this metal in 1 year. It takes 2 years to do it.

Dr. FLEMMING. That is right.

Senator MALONE. Now if you are going to get up to 35,000, you still have to let the contract. It may take 1 month, it may take 6, and then it is 2 years. So we are overemphasizing what the metal will do or we are underemphasizing the necessity for it. What I do think we can do in this committee, we can help you sell a bill of goods that you believe in if it will further the national defense efficiency. It will save the lives of these kids when you send them up next time.

Dr. FLEMMING. Mr. Chairman, I know that this country has had some experience in the past in underestimating its requirements for materials. I can think of one that has been in this discussion today quite often, aluminum. There was a time when that was underestimated and we had to pay the bill in a great many ways because it was. As I see it, in this area we have to be very careful that we do not make the same kind of mistake.

I have had nothing presented to me by any of our people, by Defense, nor have I heard anything here this morning which would put me in

a frame of mind where when the next proposal for expansion of production comes before us, which I understand it will very shortly, I would say, "Don't do it." As far as I am concerned, I would say, "Go ahead."

Senator MALONE. Dr. Flemming, I appreciate your being here. Your testimony will come down to you, and if you have any further information we will appreciate having it.

Dr. FLEMMING. I will be very glad to supply it.

Senator MALONE. You do not lack money in letting these contracts in case it is necessary?

Dr. FLEMMING. No. At the moment we are all right. Before this next session of Congress, however, we may want to revise our figures along that line.

Senator MALONE. Do you have any particular difficulty building planes if you ask for them?

Dr. FLEMMING. My responsibility has been in the area of strategic minerals and metals. Whenever we have presented that request to Congress, it has been granted.

Senator MALONE. You know we are still dependent on nations across the ocean for materials that we cannot fight a war without?

Dr. FLEMMING. Yes. You know, Mr. Chairman, that is why we put into effect what we call our long-term stockpile policy; namely, a policy where we discount our foreign sources of supply 100 percent and proceed to build up our stockpile accordingly.

Senator MALONE. Did we furnish you a copy of our digest of the 10 volumes of testimony, as we call our report?

Dr. FLEMMING. Yes.

Senator MALONE. In that report it says—and the committee decided after hearing the military strategist—that you could defend this Western Hemisphere and that that is all we can do in the first go-around; that you are going to be caught right here in the Western Hemisphere, and as you start winning the war you will get back these other areas—we hope. But a plane in India or Algeria is a total loss hours after the war starts.

Dr. FLEMMING. Yes, sir; and our stockpile objectives rest back on that belief.

Senator MALONE. What about our going-concern capacity?

Dr. FLEMMING. As I indicated a little earlier, we are interested in that.

Senator MALONE. Within the area you can defend, and that is the Western Hemisphere?

Dr. FLEMMING. Yes.

Senator MALONE. Now, we come right down to this one thing, and we have spent more time on it than anything else because it just seems that there is no place to pin it down. That is the only thing we have not been able to pin down.

I think if you read this testimony, it will be in there; that we let contracts for a certain type of plane and then we asked the users how much titanium they wanted and we get back exactly what we send out. Somebody somewhere has got to sit down in the cool of the evening and figure out whether this metal is needed at all or not.

If the General Electric is correct, maybe it is not. But if it is, that is the first thing; then how much of it is needed to make the maximum

speed and range plane so we can keep ahead of anyone else in the business, if that is what we want to do. I read headlines this morning that the Secretary of State says we are going to be very much closer to the Kremlin now because it is a trade war. I do not understand that kind of statement when you contrast it with a statement that we are about to go to war. So some of us are trying to pin it on 2 or 3 different things: First, if we are in danger, according to our experts; and second, what we need to make the things we have to have to win it if we get in it. Right now, unless this testimony reads different outside of your own—and I think it will—we still do not need any more titanium than we have. We have too much.

Dr. FLEMMING. Mr. Chairman, as for fixing responsibility on the issue of increased capacity for sponge production, I hope we will always be in a position where we can justify why we authorized General Services Administration to enter into any contract. I also hope we will always be in a position to justify why we didn't authorize General Services Administration to enter into a contract, if that should come.

Senator MALONE. When we get into trouble, it will be too late for anybody to do anything. Then we will just change the whole thing around, and the fellow will get fired who is responsible for all of it. Then we will have a new program after we kill another million kids.

Dr. FLEMMING. The responsibility for deciding whether the Government should enter into a contract for increased capacity for sponge production rests with the Office of Defense Mobilization, and I can assure you we will not try to duck it. You can always turn to us and find out why we did or did not do something.

Senator MALONE. Let us assume that it has been established, which I do not think it has this morning, that you need more titanium contracts let; it is not certainly by the authorities that know, but if it were, if they said, "We need 100,000 tons of titanium 2 years from now," are you letting those contracts as fast as you could?

Dr. FLEMMING. I do not know whether people would come in with proposals that would make it possible to do that or not.

Senator MALONE. This list is confidential; is it not?

Dr. FLEMMING. Yes. I would say that our experience to date would not point in that direction, but I am right back to the point of the present situation, Mr. Chairman. In the light of the information which has been made available to me, which includes the information that has been made available to you in your capacity, I see no reason at all for writing a letter to GSA and saying, "Don't enter into any more contracts for expansion." I still feel that the proposals which are now pending are worked out along sound lines from a financial point of view. General Services Administration has assured they will meet specifications, and so on. Those should be approved.

Senator MALONE. Mr. Gumbel, will you come up here where we can hear you.

STATEMENT OF IRVING GUMBEL, DIRECTOR OF MATERIALS DIVISION, EMERGENCY PROCUREMENT, GENERAL SERVICES ADMINISTRATION, ACCOMPANIED BY ALBERT GREENE

Senator MALONE. Will you state your name and position?

Mr. GUMBEL. Irving Gumbel, Director of Materials Division, Emergency Procurement, General Services Administration. This is Mr. Albert Greene.

Senator MALONE. I am not going to ask you how contract negotiations are progressing. I assume if is classified information.

Mr. GUMBEL. I do not think it is classified, but I do not think it is appropriate to reveal these things in a public hearing.

Senator MALONE. I notice you are dealing with some very substantial people.

Mr. GUMBEL. Correct.

Senator MALONE. If it were shown that you need twice or three times as much titanium as the amount that has been set as a ceiling by the National Defense Administration, are you letting these contracts as fast as you can let them?

Mr. GUMBEL. Yes, sir.

Senor MALONE. You could not speed it up any way at all?

Mr. GUMBEL. We could not speed it up prudently. We would have to give these people much greater inducements than we plan to give them.

Senator MALONE. Are they holding back on the type of contract you are offering?

Mr. GUMBEL. No, sir; I do not think so. Of course, in the first place these contracts involve very time-consuming preparations; not from a legal point of view, but these people have to arrange their financing, they have to find appropriate location for the plant. There is a vast amount of engineering. On the last Du Pont project I think they took about 8 or 9 months just to do the preliminary engineering. So it is time consuming. That is part of that 2½ to 3 years that you are talking about.

Senator MALONE. How long does it take to build a plant after you actually sign the contract?

Mr. GUMBEL. Senator, that is an exceedingly difficult question. Theoretically, they should be able to build a plant in 18 months.

Senator MALONE. I am talking about 18 months to 2 years. That does not include the 9 months you fool around.

Mr. GUMBEL. That is right, it does not include that. There is 18 months of actual construction and then you have the problem: When they turn the switch whether the titanium is going to come out.

Senator MALONE. Six months estimated to get under production is probably not too small an amount of time. That would be 2 years. In the 9 months you take around Washington added to that, that is 3 years.

Mr. GUMBEL. That is right. That 9 months is not entirely our fault. There is the contractor who is responsible for a good part of that.

Senator MALONE. What would we do in case we really got in a hurry to do something? You have already written several of these contracts. You do not mean it takes 9 months to write one?

Mr. GUMBEL. No; it takes 9 months to complete all the preliminaries.

Senator MALONE. Has the Kennecott Co. got a contract yet?

Mr. GUMBEL. No.

Senator MALONE. Suppose you were to bring a company like the Kennicott Co. in. You know they are going to do anything they say they will do. Do you think it will take 9 months?

Mr. GUMBEL. They are not ready to enter into a contract. They have just completed their pilot plant. They want to operate their pilot plant for at least 6 months before they are willing to make up their mind whether the thing is feasible.

Senator MALONE. Are they all in that condition?

Mr. GUMBEL. They are all in some fairly preliminary stage except, of course, the Du Pont contract, which is nearly concluded. There are a couple of other contractors that are near the point where they are ready to go ahead.

Senator MALONE. Then no matter how bad you need titanium, you could not do anything about it, you could not let the contract?

Mr. GUMBEL. The only thing you can do, of course, if we are in a shooting war, would be what we did with rubber during the last war. We would go ahead and build the plants and hope that they would run. I do not think anybody advocates such a course at this time.

Senator MALONE. How many are you dealing with that think they can make it if given a contract; that they are ready?

Mr. GUMBEL. There are none of them ready except the two I mentioned.

Senator MALONE. You know you are getting ready to buy from Japan. I guess you know that.

Mr. GUMBEL. No, sir.

Senator MALONE. Would you advise, in your capacity, knowing something about the distances between here and Japan, that you become dependent on any nation across a major ocean?

Mr. GUMBEL. That is a little outside the responsibilities of our agency. I thing that would be a determination for Dr. Flemming to make.

Senator MALONE. I think it is. I might ask that question of Dr. Flemming.

You are aware of all this talk that we must buy everything that Japan has to offer now, which includes titanium. What do you think about becoming dependent for part of our titanium on Japan at that distance?

Dr. FLEMMING. I would answer that question just as I would answer in relation to any other strategic materials. Instead of becoming dependent, we should do everything we can to avoid dependence. That is the philosophy behind our stockpiling program. If I have a serious deficit in my stockpile for a particular material, and I cannot get it—I mean, we can get it from this country and this hemisphere but we still are not getting enough, I will buy it any place we can get our hands on it.

At the present time we will buy nickel, as you appreciate very well, wherever we can get it; but when we buy it for the stockpile from a foreign source, we do not assume that that means that we can depend on that source in the event of war. We are just getting it for the stockpile so as to lessen our dependence on the source of supply.

Senator MALONE. You have the spectacle now of the people producing the nickel rationing it to the users. That is not very helpful, either, and it is available elsewhere. Now it does not seem that Japan has all this trouble of getting titanium manufactured. They seem to be able to produce it, according to the people we have talked to from there, in about any amount you want.

Mr. GUMBEL. Well, they actually are producing very small quantities, and they would be willing to increase their production, but I do not imagine they would be able to do it any quicker than the people can over here. I still think they would be talking about 2 or 3 years.

Senator MALONE. Mr. Secretary, have you anything else to offer?

Mr. LEWIS. Yes, I do, Senator. I am not sure, but I think perhaps you may have misunderstood something I said this morning. Several times you have indicated that the Air Force has reduced the stated requirements. The Air Force has not reduced or changed its stated requirements as given to the Department of Defense.

Senator MALONE. I did not indicate they had reduced it; I just indicated they had not looked ahead to increasing it.

Mr. LEWIS. We are looking ahead.

Senator MALONE. How long have you been looking ahead?

Mr. LEWIS. We are looking all the time. We have these programs continually under review.

Senator MALONE. You have been at it 2 years now, have you not? You have been looking ahead for 2 years now without increasing the requirements?

Mr. LEWIS. Yes, because there are offsets. The testimony this morning is indicative of the kind of evidence that comes to the Air Force all the time. There is disagreement in the industry about the potential of the material, increases and decreases.

Senator MALONE. Some of them do not think they need it at all, is that right?

Mr. LEWIS. I have not heard anybody say they did not need it at all.

Senator MALONE. You heard the testimony of General Electric?

Mr. LEWIS. He indicated there was a place for titanium.

Senator MALONE. Not very much; only 100 pounds to the engine.

Mr. LEWIS. Right now, yes.

Senator MALONE. His testimony will add up. That is all you need; you will need more eventually, but you do not have to have it. You have the light steel alloy.

Mr. LEWIS. He indicated he could use 100 pounds per engine now, and there is a potential of 900 he could not evaluate as to when it might be required.

Senator MALONE. He did not have to have the 900. Now if that is true, steel alloys can be made light enough so that 100 is all you have to have, and that was the indication of his testimony. Then you do not need very much titanium. Are you considering those things and that is the reason you are holding back?

Mr. LEWIS. We are not holding back. I want you to understand clearly it is a very difficult thing to appraise when you look at the long-term requirements because of the technological problems that are being dealt with daily in all of the industry.

Now, there is plenty of reason to think, as I indicated, because consumption is lower than projected, that we may have overstated the

thing; but we have not changed our requirements downward because we see other offsets that it might be more.

Senator MALONE. There is a chance you might revise it downward, then?

Mr. LEWIS. Senator, we are going to make the best estimate we can.

Senator MALONE. When?

Mr. LEWIS. That is in process right now. I cannot say when it will be completed.

Senator MALONE. We will have to wait a couple of years.

Mr. LEWIS. Not this last review; no.

Senator MALONE. You heard the representative of Curtiss-Wright testify that they have not been given the orders to do the job?

Mr. LEWIS. Yes; I heard that.

Senator MALONE. Is that true?

Mr. LEWIS. The Curtiss-Wright Co. made a proposal to the Air Force in August of this year, and that proposal has been under review and study because there are some special ways of financing involved in it. As I think Mr. Hurley indicated, it is in the process of being given to the Curtiss-Wright Co. They do not have a firm signed order at the moment, that is true, but I am sure that they are going to get an order along the lines of their proposal.

Senator MALONE. I hope they get it before we get in a fight, in case we need the planes. Do you need them?

Mr. LEWIS. Do we need improved airplanes?

Senator MALONE. Yes.

Mr. LEWIS. Absolutely.

Mr. HURLEY. Titanium is a substitute for nickel in many instances, and we are going to be forced to use titanium regardless of some of our opinions. I talked to some of the directors of the Nickel Co. about it. Some of them felt strongly enough about that to say they would advocate such a thing. In our weighing of steel and titanium, I think we are going to have to offset nickel. We may not get it in the quantities we think we need.

Senator MALONE. You heard the testimony this morning that lightweight steel alloys would take the place of most titanium?

Mr. HURLEY. There will be some that will take its place. I think the representative of General Electric is referring to that particular engine. In addition to those engines, there will be engines that will use a lot of titanium, regardless of the maximum numbers.

Senator MALONE. He did not mention them.

I appreciate, Mr. Gumbel, that you have kept us advised of these negotiations. We have held them in confidence, as you have suggested, and we will continue to do so.

Mr. GUMBEL. We will continue to send them, sir.

Senator MALONE. Is there anyone else that I have not called on that may have anything to offer?

If there is not, we will return the testimony to each of you who appeared. If you have any second thoughts, I hope you will include them in your corrected testimony.

The Chairman does not understand to how you are going to have the titanium on hand needed to make these planes when it takes 2 years to 2 years and a half, as has been testified here, to negotiate a contract and get underway, if you wait 1 year, 2, or 3 years until you have perfected the alloys. Also, of course, we did not go into that

phase of it, but we do know that titanium is a substitute for some very important critical materials. The tonnage I do not suppose would be so great, but it will increase the amount needed.

So I want to say to all of you, Dr. Flemming and others, that I appreciate very much your taking your time. I know you are all busy.

We will recess to the call of the Chair.

(The following was subsequently received for the record:)

STATEMENT OF F. A. MCGONIGLE, VICE PRESIDENT AND GENERAL MANAGER OF MANGANESE, INC., PERTAINING TO POWER REQUIREMENTS

In response to your telegraphic advice of October 14, and the request contained therein, the following information regarding our power situation is submitted in quadruplicate.

Manganese, Inc., has two contracts with the United States Government, through General Services Administration for the delivery of manganese nodules of specification grade. One contract GS–OOP–(D)–12062 is for the delivery of 27,500,000 long-ton units of finished manganese nodules from our own ores mined from the Three Kids mines. The other, Contract GS–OOP–316 (SCM) is for the beneficiation and delivery to the Government of 5,500,000 long-ton units of manganese nodules from Government stockpile ore.

In September 1951, formal request was made to the State of Nevada through its Colorado River Commission for an allotment of electrical energy in order to carry on the mining and milling operations of our plant. The original estimate and request was for 18 million kilowatt-hours of the Hoover-Davis-Basic plants pool power at 3 mills per kilowatt-hour, but before a contract could be negotiated by us, all but 6 million kilowatt-hours of this cheap power had been contracted for by the other Basic plants. Under date of April 26, 1952, we were given a firm contract by the State of Nevada, Colorado River Commission for this 6 million kilowatt-hours at the pool rate of about 3 mills. Subsequently formal request was made for an additional 12 million kilowatt-hours of firm power, in anticipation of our future needs, and the request was finally upped to 30 million kilowatt-hours more, at a total demand of 5,100 kilowatts. Because of the low level of Lake Mead waters this year there has been a 12 percent cutback in power production from Hoover powerplant, and a 10 percent cutback at Davis powerplant and with the additional demands for power of the Las Vegas Valley Water District, and expansion of our plant and others, an acute power shortage exists. The Colorado River Commission of Nevada has diligently negotiated and sought other sources of power to meet the demand, with nothing definite to offer to date.

We are using approximately 2,250,000 kilowatt-hours per month, at a demand of 3,700 kilowatts at our present rate of operation.

To alleviate the power shortage that looms, the Southern Nevada Power Co. of Las Vegas has come to the rescue with the commencement of construction of a steam powerplant near Las Vegas. We are now negotiating with this company for a contract. They have indicated their willingness to furnish us with steam power to meet our requirements, at a rate substantially higher than we are paying for the 6 million kilowatt-hours per year we now have under contract through the Colorado River Commission. They expect that their steam powerplant will start operation by the end of 1955, but they can furnish us with power beginning July 1955.

As stated above, our original requirement was estimated to be 18 million kilowatt-hours per year, at a 2,566 kilowatt demand, and in September 1951 a formal request was made to the CRC for that amount. Of the amount requested, we have a firm contract for 6 million kilowatt-hours at a 2,566 kilowatt demand. Our operational needs have far exceeded our original estimate and requests have been made for additional energy. In March of this year a projected schedule of our requirements was submitted to the Colorado River Commission, as follows:

	Kilowatt-hours per year	Kilowatt demand
From August 1954 through December 1955	30,000,000	4,000
From January 1956 through December 1957	35,000,000	4,500
From January 1958 through December 1960	36,000,000	5,100

COLORADO RIVER COMMISSION OF NEVADA,
Henderson, Nev., December 1, 1954.

Senator GEORGE W. MALONE,
Senate Office Building, Washington, D. C.

MY DEAR SENATOR MALONE: Pursuant to telephone request today from Tom Smith, we send you herewith, airmail, estimated power use for the current operating year and 1955–56 operating year for the Basic contractors and the southern Nevada contractors, with estimated average rate for such delivery. This estimate is made as of December 1, 1954.

The 1954–55 operating year figures vary slightly from those in the tabulation and charts we have sent to Mr. Adlerman, due to the reassignment and reapportionment of Davis excess energy for the current operating year.

We trust this is the information you desire. May we be of further assistance to you?

Very truly yours,

A. J. SHAVER, *Chief Engineer.*

Estimated use

Contractor	1954–55 operating year	1955–56 operating year	Estimated average rate (mills)
Basic Management	28.92	25.65	5.6
Cal-Pacific	30	36.20	3.6
Combined Metals	86.10	89.10	3.3
Manganese, Inc	28.74	31.5	5.6
National Lead	101.4	151.2	3.3
Stauffer	208.17	224.0	3.9
United States Lime	5.50	5.40	3.3
Western Electrochemical	182.86	300.0	3.3
Total BMP	671.69	863.05	
Southern Nevada Power Co	388.0	415.5	3.8
Lincoln Co., power division	43.75	54.5	2.2
Overton Power District	10.06	10.08	2.2
Total, southern Nevada contracts	441.81	480.09	

NOTE.—Above estimates as of Dec. 1, 1954.

(Whereupon, at 1:35 p. m., the committee recessed, subject to the call of the Chair.)